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S. D. KIRKPATRICK, *Editor*

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Plans and Specifications For a New Leadership

MANY MEN in chemical engineering industries are being adversely affected by economic conditions over which they have had little or no control. As individuals, these men are beginning to question the validity of an economic system that penalizes their progress by periodic depressions. They resent the idea that uncontrollable forces can disrupt their businesses, throw them out of their jobs, or otherwise break down the economic security to which their energy, ability, and experience rightly entitle them.

UNFORTUNATELY, their protest, as long as it is voiced individually, seems likely to prove ineffective. The job to be done is one that requires the thoughtful, planned co-operation of every man, company, and industry that goes to make up the business structure of America. To start this great program of reconstruction and stabilization, there is the obvious need for the formulation and statement of fundamental principles and policies. Only in this way can so diverse interests find a common ground on which to base their co-ordinated effort.

BECAUSE this is a responsibility of industry in which the business press has an unquestionable obligation, the editors of the McGraw-Hill company, with the co-operation of many eminent business men and economists, have attempted to bring together such a statement of principles. "The Platform of American Business," which appears as a supplement to this issue of *Chem. & Met.*, is earnestly commended for your study and constructive criticism. Subsequent issues will deal specifically with some of its applications in the process industries.

READERS of this platform will see in it many planks that have already received some emphasis in these columns. Prominent among them is the need for the longer look ahead; i.e., the planning of research, production, and distribution on a three- or five-year basis; the desirability for greater co-operative effort through trade associations and similar agencies, particularly for better statistics and trade practices; the encouragement of private initiative—self-government as opposed to the extension of federal regulation and control—and, as basic to all other considerations, intelligent, far-seeing management that, through adequate wage scales and sound employment policies, will help maintain, if not improve, established standards of living.

BUT, despite the apparent futility of individual effort, the really great opportunity for the chemical engineer lies in the application of his knowledge of these fundamental principles of business as a whole. Too many of us have been concerned with the job immediately at hand. Too many are willing to leave to others the thinking and responsibilities for the broader policies of the company or the industry. The real test of leadership today in technology or industry requires something more than the mastery of some branch of science or engineering. Essentially it is the vision to see beyond the present in order to plan the future. Someone has said that the leaders of American business for the next ten years will be developed during the next ten months. Definite plans and specifications for such leadership are not available except for the basic requirement of a broader knowledge of sound economic principles and practices.

EDITORIALS

MARCH, 1931

An Exposition Of Opportunities

TWO years ago, at the time of the twelfth Exposition of Chemical Industries, the country was at the peak of a curve of unprecedented prosperity and droves of near-economists were noisily proclaiming the death of the business cycle. Two months later the business curve began to drop, and what had promised to be only a chuck hole in the path became eventually a full-fledged valley. Now, two years later, the world's business is dragging bottom, waiting for whatever push is necessary to start it on the slow ascent. Chemical industry must be ready when the push is given, for laggards are going to find the next decade harder sledding than the last. Cleaning house in technology is going to be just as imperative as in the antiquated and short-sighted business methods that precipitated the depression.

This is why the present, or more exactly May 4, is a peculiarly opportune time for the opening of the thirteenth Chemical Exposition. If previously we have needed the contacts it engenders and the information in regard to new methods and improved processes it provides, we need them doubly now. Although business has been bad, the industry has not marked time. There has, in fact, been a catalyzing of effort toward greater efficiency, as will clearly be reflected at the show. Improvement in design is to be the keynote, just as it is to be the theme of *Chem. & Met.'s* next issue. Opportunities will be waiting there for every chemical engineer. What potentialities they hold for him will depend largely on his own recognition of the fact that they are opportunities.

An Engineering Appraisal Of a Familiar Gold Brick

IN THE long and unsavory history of the Congressional failure to solve the Muscle Shoals problem, there have been few measures as patently political as Senate Joint Resolution 49—the Norris bill for government operation. And, by the same token, President Hoover's veto message is perhaps the most competent analysis that has yet been made of this troublesome issue.

With the directness and conviction of an engineering report, the President first marshals indisputable facts and figures to show that, even with efficient management, the federal government could not expect to make a success of the power and fertilizer manufacturing businesses. Under most favorable circumstances and after an additional new investment of $127,000,000, the government would stand to lose at least $2,000,000 a year on the electrical project alone. Next, on the basis of the bill's own specifications for the personnel of its board of managers, the President shows that its administration would be in the hands of men selected on the basis of their political beliefs rather than their technical experience competence. Finally, on the broader ground of fundamental principle, President Hoover takes his stand squarely against the entry of government into any business in competition with its citizens. Power, he holds, is no exception unless produced as a byproduct of flood control, reclamation, or the improvement of navigation. Thus, Mr. Hoover makes no attempt to dodge the "Power Trust" issue, with which his opponents would tar his political future. If the power industry has abused the public confidence, "the remedy lies in regulation and not by the government entering into the business itself."

One of the clearest concepts of the whole veto message is seen in the reference to the problem of producing nitrogen fertilizers in a more or less obsolete plant, to be sold in the wholesale market of a highly competitive business. He concludes, with assurance, "that no chemical industry with its constantly changing technology and equipment, its intricate problems of sales and administration, can be successfully conducted by the government." Chemical engineers have reason to concur in this conclusion.

The President's suggestion that the whole problem should be turned over to the states of Tennessee and Alabama has at least the merit of taking it out of the arena of national politics, where it has had an inordinate amount of attention, and returning it to the local communities primarily concerned with its practical development. Somehow one cannot escape the feeling, however, that Muscle Shoals has become a political gold brick for which it will be more and more difficult to find a customer.

New Agencies for Industrial Development

MOST communities have now come to recognize the necessity for substituting specific facts and engineering data for the fulsome generalities that once were so common in the promotion literature of the chambers of commerce. But New Orleans now proposes to go a step farther, and provide an industrial chemical laboratory where new processes and products may be studied in relation to native raw materials. Here the manufacturer interested in the commercial possibilities of the region could definitely appraise its resources and their probable development under existing local conditions. Likewise this laboratory would be the logical place for privately and publicly endowed research on technical problems of broad interest to the whole community—such, for example, as the use of southern pine and native hardwoods in the production of sulphite pulp.

More recently has come the announcement from Baton Rouge of the establishment of a chemical process institute at the Louisiana State University for the purposes of developing and improving those chemical engineering processes having to do with the industries of the state. Whether these two agencies will ultimately be fused or co-ordinated in their common purpose has not yet been indicated. In any event, however, the industrial and scientific leaders of Louisiana are to be commended for this forward looking proposal to enlist chemical research in the interest of industrial development.

Independence for America's Rubber Industry

MOTHER NATURE is a jealous and often obstinate mistress. In the growing of rubber, for example, she has not permitted man to duplicate or even greatly expedite her processes. Despite the fact that the United States annually uses over a billion pounds of rubber, or 60 per cent of the world's output, climate and labor have conspired to prevent growing the hevea, or plantation rubber tree, in this country. This is not true, however, in the case of the guayule shrub, and in this direction there has recently been interesting progress.

As a matter of fact, it would be a most logical thing to create a reserve of guayule rubber in this country. The shrub lives and grows indefinitely, forming, in fact, a warehouse, for there is no destruction of the rubber once it is formed. As an example, if 150,000 acres was planted and the shrubs allowed to grow for ten years, they would form a living warehouse of 3,000 lb. of rubber per acre, or a total of 450,000,000 lb. would be in "storage." Harvesting ten per cent of this crop per year with replanting of a like amount would maintain this supply. Other than taxes, this growing warehouse would need no attention or investment after the beginning of the third year.

In this issue, *Chem. & Met.* is privileged to present an account of the beginning of such an industry in the United States. With rubber selling at around eight cents per pound, it is not likely that this venture will grow very fast. Yet the patience of the capital behind it has already been demonstrated, and when the price of rubber returns to higher levels, we may well expect it to contribute substantially to the independence of the American rubber industry.

Licensing the Chemical Engineer

CHEMICAL engineering will be given official recognition as a branch of the engineering profession in Oregon, if the Legislature of that state passes an act now before it, which amends the existing law regulating the practice of engineering. In that portion of the new act defining the practice of professional engineering, "chemical processes and operations" are included among other additions. Further, the personnel of the examining board has been changed by the proposed act to include one chemical engineer. This proposal, coming at a time when more than half of the states of the Union are definitely committed to some form or other of licensing, emphasizes the present need for a national study of the chemical engineer's relations to such legislation.

Within the engineering profession there is already an organized effort to force the enactment of licensing or registration laws. Often this objective has been accomplished even in the face of opposition from the older engineering societies. Chemical engineers, at least for the most part, have not been prominently identified with either party to this discussion, although it is well known that many are openly hostile, resenting any attempt to set up fixed and arbitrary standards in a profession as yet undeveloped and accordingly far from standardized. On the other hand, there is definite evidence in some states that the license laws, even though poor and inadequate, have succeeded in making it more difficult for unethical or incompetent individuals to practice as professional engineers.

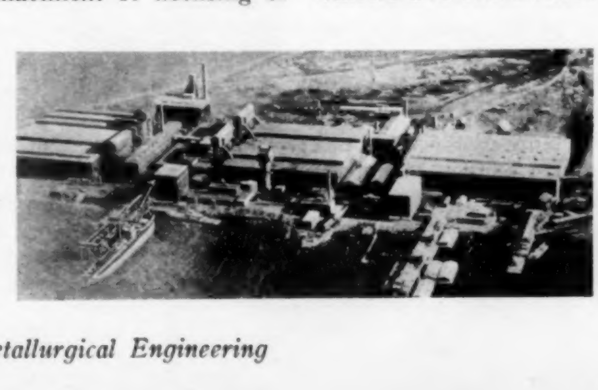
Whether we like it or not, registration laws do exist and will continue to be enacted. Therefore there is an opportunity for the engineer to join with others in an effort to improve these laws, so that they may serve a more useful and constructive purpose. To give direction to this effort, the major engineering societies, among them the American Institute of Chemical Engineers, should agree upon a permanent policy with respect to the whole subject of registration and licensing.

The Case for Congeniality

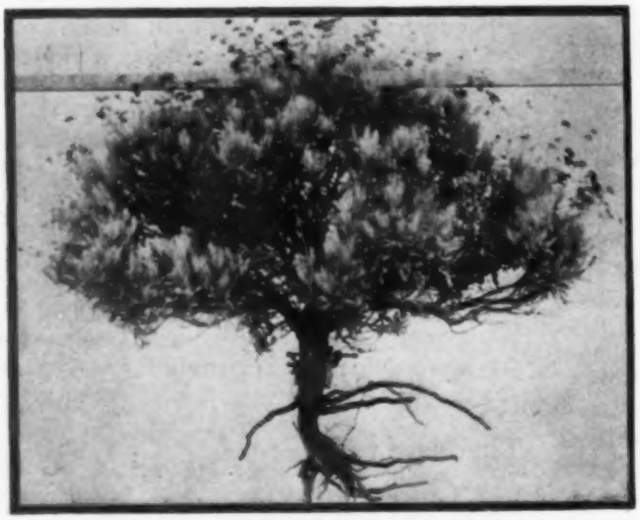
BY NATURE man is a social animal. He cannot live by bread alone nor by the sweat of his brow, nor yet from the exercise beneath it, without realizing his dependence upon his fellows. Even chemists and engineers, supposedly buried in scientific research and the exploitation of profitable processes, are prone to human foibles, particularly if they can be caught around a luncheon table or at a game of billiards or bridge.

So twenty years or more ago when a group of enlightened spirits, encouraged by the leadership and example of the late Morris Loeb, founded a Chemists' Club in New York, they recognized a deep-rooted human need for professional companionship. That their idea was sound, the club's brilliant history has well demonstrated. That the spirit of chemical congeniality should eventually outgrow and outmode its structural cloak was only to be expected. And that an ambitious building committee—Kilsheimer, Marks, and Marshall—with a battalion of conscripted assistants, should be willing to dedicate themselves to a good half year's toil in the rejuvenating and modernizing processes, was all indicative of the club's underlying idea.

When the choice had to be made between the interchange of acquired knowledge as represented by the historic and somber Rumford Hall and the cheerful conviviality of a comfortable lounge, it was not surprising to find the decision in favor of congeniality. For after all, it is a human institution. As such *Chem. & Met.* salutes the "new" Chemists' Club and its energetic officers and committees.



AMERICAN-GROWN RUBBER PRODUCED



At Four Years, Guayule Attains the Maximum Rubber Content of 16 per Cent of the Dry Weight, Including Roots

When, in the late nineties, the coffee plantations in several of the Federated Malay States were wiped out by a contagious leaf disease, rubber trees were planted from seeds, the parent stock of which was smuggled out of Brazil to England years before. Resulting plantations now supply the world with more than 95 per cent of its rubber and account for an investment of a billion dollars.

On the high, arid plateau of central Mexico, with a small projection extending into Texas, there occurs as a natural growth a shrub or miniature tree locally known as guayule (*Parthenium argentatum*) and world-wide search has failed to find it anywhere outside of this area of about 130,000 square miles.

RUBBER, in common with such substances as coal and petroleum, belongs to the general class of hydrocarbons which has contributed so much to modern civilization and human happiness. Coal and petroleum are the stored-up fossiliferous remains of earlier world plant life, but of rubber there are no stored reserves. It is formed in the tissues of certain living plants and so far has little use in its pure state. Other substances are added, usually because they lend valuable properties not possessed by rubber alone. This blending is followed by vulcanization. The proportion of new rubber used in rubber goods varies from 10 to 90 per cent. Reclaimed rubber makes up the remainder.

Before 1910, practically the entire rubber supply came from wild sources; the bulk of it from the Amazon Valley, where both hevea and castilloa trees are native; but also from African vines and grasses, from ficus and other trees native to the Middle East, from castilloa trees found in southern Mexico and the Central and South American republics, and from the guayule shrub, which, as a native growth, is found only in northern and central Mexico.

With the single exception of guayule, all these plants originally grew within a frostless band extending around the earth with northern and southern limits not exceeding 14 deg. on either side of the equator. They were found at low elevations in surroundings that were thoroughly tropical with respect to heat and humidity. In all these equatorial growths the rubber was recovered by wounding the bark and collecting the white milk which exuded therefrom. This milk was then coagulated by primitive methods or partially evaporated, the resulting solids being shipped as rubber in a moist and more or less contaminated condition, all of it requiring subsequent refinement before it could be used.

As early as 1852, it was known that the bark of this shrub carried a resilient substance which, on analysis, proved to contain 80 per cent of a distinctive resin. This gum—"guayule rubber"—can be recovered from the bark by chewing in the mouth, and it is possible that this is the way it was first discovered.

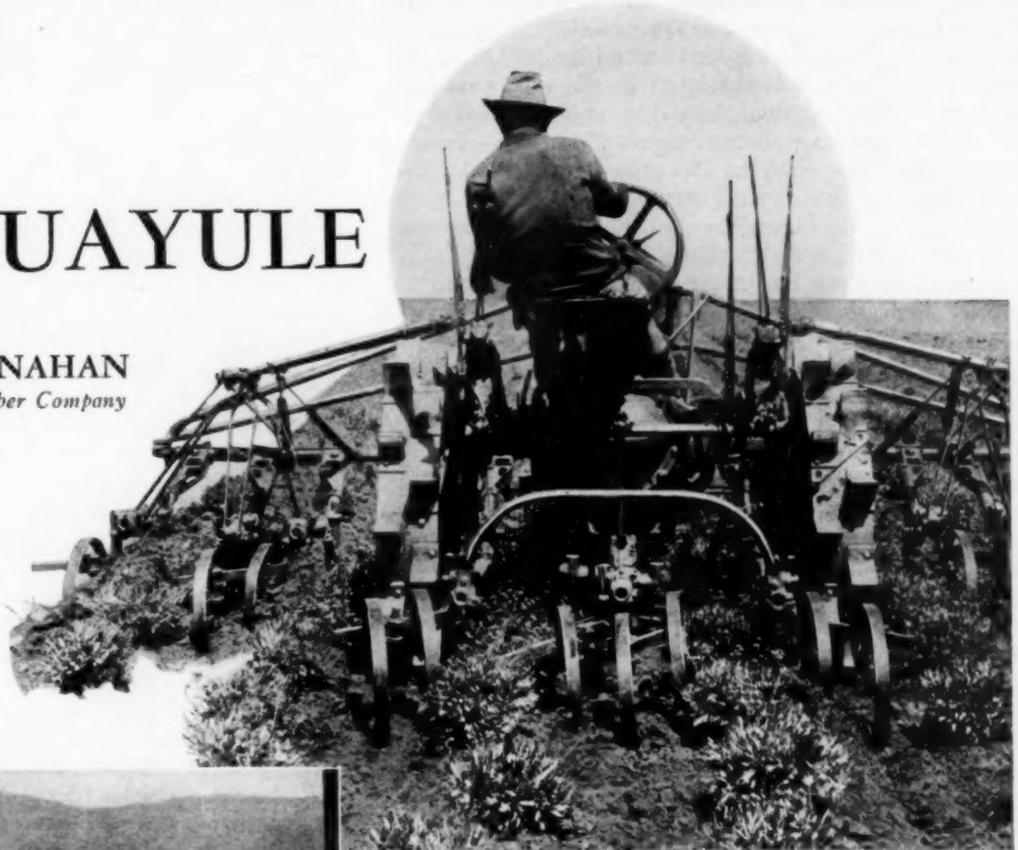
Similar as this product is to the plantation rubber of the East Indies (which has 94 per cent caoutchouc), the plants themselves could hardly be more dissimilar. Instead of the lofty tree which is native to the Brazilian forest, we have a shrub rarely over 2 ft. in height: instead of a milky sap which results from tapping and must later be coagulated, the rubber is incased in special cells of the guayule cortex; instead of the moisture and tropical conditions of the rubber plantation, with its scientific cultivation, the native home of guayule is in the high, semi-desert regions where heavy winter frosts appear to be necessary to its proper development, as is the case with other deciduous plants.

The wild guayule in its native habitat is of slow but hardy growth, attaining a height of 18 in. and a weight of a pound or more in seven years, from seed to a commercial maturity. During the dry season it is dormant, but after a week or so of rains it flowers vigorously and each plant produces a hundred or more minute seeds, few of which survive the critical infancy.

Beginning in 1888, a series of unsuccessful attempts were made to extract in marketable form the rubber known to be present in guayule. In 1900, a solvent process was patented by an Italian chemist, William Prampolini. In 1902, he succeeded in interesting Thomas Fortune Ryan and Senator Nelson W. Aldrich in his proposal, and means were provided for a thorough test—with unsuccessful commercial results. However,

FROM GUAYULE

By GEORGE H. CARNAHAN
President, Intercontinental Rubber Company



In the Salinas Valley, California, the Plants Require Cultivation for Only Two Years

Guayule Shrubs Serve as a Warehouse and Are Ready for Harvesting When Four Years Old

the potential importance of guayule as a source of rubber having impressed itself upon Ryan and Aldrich, they made up their minds to do whatever might be necessary to evolve a process that would work, and to this end they established laboratories and began an exhaustive series of experiments and studies under William A. Lawrence, ably assisted by his daughter, Clara Louise Lawrence. Their work finally resulted in a purely mechanical process, patented by Lawrence in October, 1903. The present continuous process was patented in 1928 (Carnahan, U.S. No 1671570, and others pending).

This was followed in 1904 by the incorporation of the Continental-Mexican Rubber Company (a subsidiary of Intercontinental Rubber Company), the erection of a small commercial unit at Torreon, Coahuila, Mexico; the successful sale of the product resulting therefrom; and the design and erection during 1905 and 1906 of a factory at Torreon having a monthly capacity of 1,000,000 lb. of wet rubber as then marketed (800,000 lb. dry weight). This company has produced about 60 per cent of the 160,000,000 lb. (dry) of commercial Mexican guayule rubber so far marketed. In 1910, guayule rubber made up 19 per cent of America's total rubber supply.

Thus, there is nothing new or mysterious about guayule. Improved methods of extraction and preparation have kept it second on the list of commercial rubber-producing plants, but up until this year the potential supply was limited by nature's slow and unaided reproductive process. Only its domestication and commercial cultivation in the United States is new, and there is nothing especially mysterious about that, although it has taken twenty years of scientific research to isolate

the most responsive varieties, and to develop cultural methods suitable to that complete mechanization of the entire cycle, from picking seed to milling out the rubber. This is now fully demonstrated in the new extraction plant, of 15,000 lb. initial daily dry rubber capacity, now in current operation near Salinas, Monterey County, Calif. The raw material for this comes from over 6,000 acres of unirrigated plants now growing on the lighter upland soils of the Salinas Valley previously dedicated to a marginal production of beans and barley. This has been done by the American Rubber Producers, another subsidiary of the Intercontinental Rubber Company.

Those responsible for this undertaking believe that guayule shrubs have certain inherent advantages over hevea trees as a dependable source of America's crude rubber requirements. Some of the reasons for this belief are as follows:

1. It is probable that nature gave rubber, suspended in a creamy liquid, to hevea trees as a sealer of wounds in the cortex and that current manufacture is confined entirely to a replacement demand. In a mature tree the rubber content does not represent more than a fraction of one per cent of its dry weight at any given time. In order to obtain an average production of 4 lb. of rubber per year, each tree has to be subjected to 180 delicate cutting operations by highly trained "tappers," each operation yielding an average for the entire Eastern planted area of about one ounce of liquid per day, of which one-third is dry rubber. The coolie tapper receives 20 cents a day. The flow from each tree is collected, the cups are washed, and the latex is carried to the estate factory, diluted, coagulated with acid, washed, sheeted, and hand-escorted through a smoke house for ten days, when it is ready for boxing and shipping. The direct production of rubber accounts for about half of the coolies on an average estate. The other half are needed for cultivation, weeding, and soil conservation. Higher yielding strains of budded hevea trees are now being extensively subjected to experimentation, but, from an American standpoint, the difference is only one of degree.

2. Quite on the other hand, nature placed the rubber in the guayule shrub as a concentrated reserve food supply, on the same principle that reserves of starch and sugar are built up by other deciduous plants against the annual recurrence of active spring growth and reproductive effort. In the special varieties bred and selected for cultivation by Dr. W. B. McCallum, chief botanist for Intercontinental, during the past twenty years, the pure rubber content of suitably handled four-year-old plants can be built up to 16 per cent of their dry weight, including roots but not the leaves shed in harvesting. From a chemical standpoint this pure rubber is like standard hevea rubber, but in the mechanical method of extraction certain resins, also carried by the plant, are incorporated in the product, in which form there is a ready market for more than has ever been produced, but methods have been fully developed by the company's chief technician, Dr. David Spence, to remove these impurities whenever there is a commercial incentive to correspondingly shrink the weight (U. S. Bureau of Standards Bulletin No. 353, Sept. 23, 1927).

3. Because Intercontinental also owns a large producing hevea estate on the Island of Sumatra, Dutch East Indies, it is possible to make the graphic statement that a ton of improved Ampar guayule rubber can be produced under the complete mechanization already applied, with an expenditure of one-sixteenth of the number of man-hours now required to produce a ton of rubber from the average hevea estate in Malaya. However, our farmers and mechanics will each receive a wage equal to that of twenty coolies.

With over 25,000,000 automotive vehicles in operation in the United States, who will deny that our modern civilization depends on the convenience of this method of transportation? Also, who will deny that its continuance depends on a continuing supply of suitable crude rubber? Is an adequate future supply from existing restricted sources reasonably assured? We are sure that it is not, and for the following reasons:

In its native habitat, the Amazon Valley, contagious leaf diseases fatal to hevea are known to exist. They are similar to our chestnut blight and the blight that wiped out the imported Liberian coffee trees in Malaya. We now depend on these native areas for about one-third of our total supply, but there is no reason to suppose that the blight could be overcome on the better cared-for estates of European or American ownership.

If we are ever isolated from the Orient in war time, our armed forces would be handicapped by lack of an essential commodity. It is this phase alone that has

Plants Are Uprooted and Air-Dried, Then the Harvester Picks Them Up, Chops and Blows the Chopped Material Into Trucks

Salinas (Calif.) Factory of the American Rubber Producers, Inc.

stimulated Thomas Edison in his efforts to develop means to overcome such a shortage quickly. He has repeatedly stated that his plans do not include commercial or competitive production in America, that he would be satisfied with a demonstrated cost of $2 per pound, and that he saw no reason for duplicating Intercontinental's exhaustive development of guayule, even if time permitted. The small quantity of rubber in goldenrod is confined to the leaves, whereas in guayule it is found in trunk, root, branches, and twigs, with some in the leaves.

Practically our entire supply of rubber now depends on the continued docility of a million Orientals. This is quite aside from the fact that British and Dutch capital produces 90 per cent of all rubber, while American capital produces only 3 per cent, although consuming 60 per cent of the world output.

Thus, there is now available for the first time an effective form of insurance against a prolonged shortage of raw material essential to our modern civilization, and which at the same time provides a greatly needed new farm crop inured to a sparse supply of water and adapted to large areas of marginal grain and cotton lands—this aside from the fact that under normal conditions the United States sends $300,000,000 per year out of the country for its rubber supply. There can be little doubt that our national common sense will see to it that the job is done.

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Metallurgical Methods Used In Producing Rubber

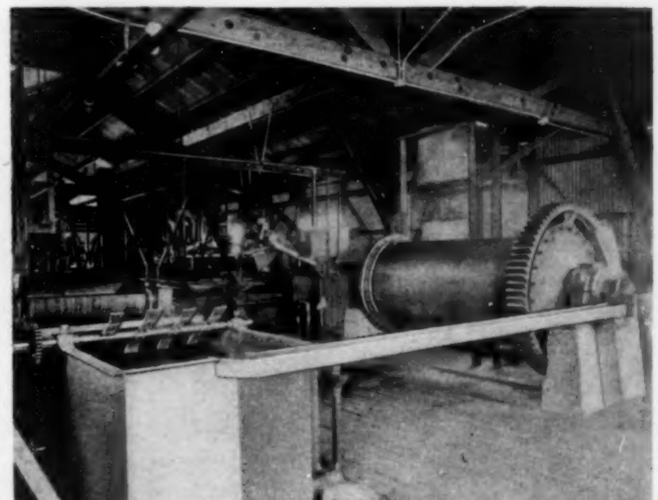
By PAUL D. V. MANNING
Pacific Coast Editor, Chem. & Met.

PROCESS industries of the United States have frequently depended almost entirely for basic raw material supplies upon foreign sources. This is true of the rubber industry, although it is the world's major consumer of crude rubber and annually manufactures finished products valued close to a billion and a half dollars. Several factors have been responsible for this almost top-heavy fabrication activity of the industry and the almost total exclusion of the domestic raw material producing side. It takes much courage and capital to begin competition with an already established production, competition with cheap labor of lower standards of living, and competition with foreign areas dependent for income almost solely on one product.

This, however, is exactly what is being accomplished by the engineers of Intercontinental Rubber Company, headed by J. M. Williams and W. H. Yeandle, devised modifications of present-day farming machinery and new types of machines to plant and cultivate the guayule.

When nearly four years old, the shrubs are uprooted by a special tractor-drawn machine which cuts into the ground to a depth of 10 in., turning two rows of plants into one windrow. A second machine shakes the dirt off and piles four field-plant rows into one large windrow. Air-drying is then allowed to proceed until the moisture drops from 35 per cent to 20 per cent.

A new type of tractor-drawn harvester then picks up the plants, chops them into ½-in. sections, and blows the chopped material into trucks and trailers which carry it to the factory.



Refining Department in the Plant, Whose Capacity Is 15,000 Lb. per 24-Hour Day

In the new factory at Salinas recently placed in operation, one finds a close parallel between standard ore-treating machinery and processes. Screw conveyors take the chopped shrub from storage bins at the rate of 5,000 lb. per hour. The feed is automatically weighed. Blowers at the top of the conveyor chamber remove the dust. The pan conveyor controlling the feed is operated by a Reeves variable-speed drive and feeds the material through a magnetic separator to an attrition mill. A belt conveyor then conveys the material to a set of Farrell-Birmingham 4x2-ft. macerating rolls.

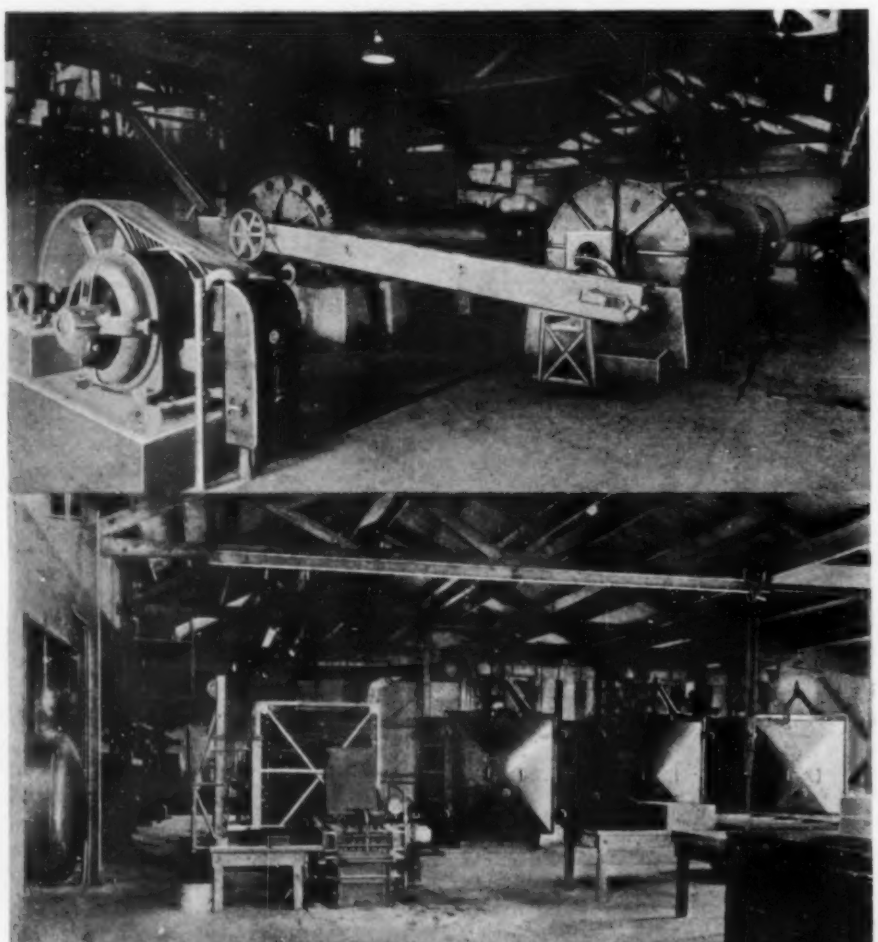
These rolls discharge into the first of four 5x22-ft. Allis-Chalmers tube mills. Water is added with the feed in the ratio of six parts to one of macerated guayule. Each set of two tube mills is driven by a 150-hp. motor. The tube mills are lined with Silex and charged with flint pebbles about $2\frac{1}{2}$ in. in diameter. The lining and rock charge weigh about 9 tons each. As the material passes through the four tube mills in series, it is ground up, the woody fiber waterlogged, and the cells containing the rubber are broken down.

The slurry discharged from the fourth tube mill passes over a Rotex screen. Slimes passing through the screen are discarded, while the material held on the screen passes into a small tank, where it is mixed by a Lightning mixer with fresh water at 100 deg. F. at the rate of about 10 to 12 parts of water to one of dry feed. A bucket elevator is used to raise this slurry to a 20x10-ft. modified Dorr thickener which serves as the first flotation cell. Rubber "worms" and some of the bark and lighter fibers floating on top are automatically skimmed off, while the waterlogged cellulose material is removed from the bottom.

Skimmed materials are passed over a small Rotex to a 4x12-ft. vertical pressure tank holding 900 lb. of rubber (based on dry weight). Hydraulic pressure of 300-350 lb. is maintained in this tank for two hours, which forces water into the non-rubber material. There are two of these hydraulic chambers, which necessarily operate as a batch system. The discharge of the material is carried out as in the case of a vertical pulp digester, the material being blown into another modified Dorr thickener, where the now almost pure rubber floats on top and is skimmed off. The heavier material discharging from the bottom of the tank with the water re-enters the process between the second and third mills.

Rubber "worms" next pass to an 8x4-ft. ball mill. This mill is fitted with flights and charged with small rubber-covered lead balls and scrubs the last traces of dirt from the rubber. The mill discharges into an oblong settling tank 12x4x4 ft., the rubber agglomerate floating on top being passed on a screen through a set of small rubber-covered rolls, which serve as a wringer, into a 10x3-ft. horizontal rotary drum. This drum breaks up the cake formed by the wringer.

The drum discharges the material, which then contains 45 per cent water, into four compartment trays, each compartment being 18x56 in. with a depth of 1 in. Each tray holds 35 lb. of rubber on the dry basis. As fast as one tray is filled it is picked up by an Economy power-driven lifter, electrically lowered, and passed to a roller-equipped holding rack. When 21 of these trays are accumulated on a rack the latter is mechanically pushed into a vacuum dryer. Three 60x80-in. Buflovak dryers are provided, the 21 trays entering one side and being discharged on the other. A 29-in. vacuum is maintained and material discharged contains 1 per cent moisture. When discharged, it is compressed by 2,500-lb. hydraulic pressure into 200-lb. blocks, 3x2x1 ft., which are cased for shipment.



Top—Tube Mills Used for Grinding the Shrub and Breaking Down the Cells Containing the Rubber. Bottom—Drying Department of the Salinas Factory

The new plant has a capacity of 15,000 lb. per total day of three 8-hour shifts. Ten men per shift operate the plant. General Electric equipment provides the motive power, a total of 580 connected electrical horse-power at 440 volts. An 80-hp. boiler fired by a Ray oil burner provides what steam is required for heating and drying, all condensate being returned through a Crane trap system.

A certain quantity of the resinous material which has been kneaded into the rubber by the process of removing the fibers is contained in the present product. This resinous material is desirable, as most of the available guayule rubber is used in coating or "frictioning" the cotton cords used in building tire casings. Guayule rubber also has a wide and proved field of usefulness in inner tubes and as a plasticizer of tire-tread stocks. Such uses would take care of the annual output of 100,000,000 lb., which is 10 per cent of the normal domestic rubber consumption. At a time when the demand arises, the resinous material can be removed either wholly or partially by methods already extensively used in the industry.

We are indebted to George H. Carnahan and J. M. Williams for permission to visit this enterprise, for their aid in the preparation of this article, and for permission to use the copyrighted photographs.

PLANT AND OPERATING COSTS

With the Low-Pressure

MONT CENIS PROCESS

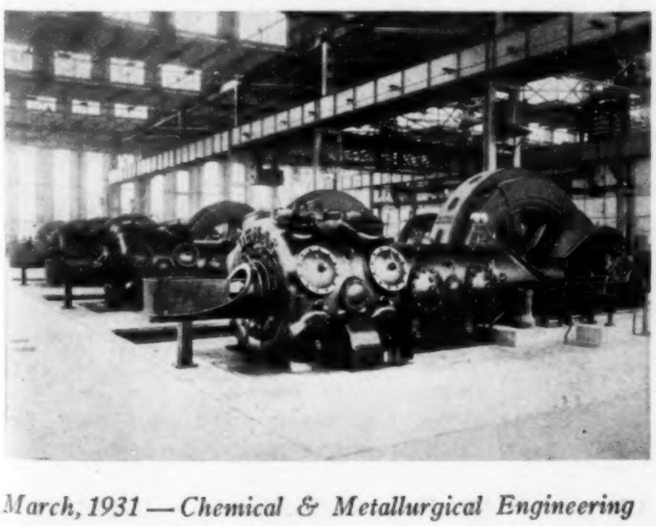
By W. F. SCHOLVIEN
Philadelphia, Pa.

The second of two articles dealing with the Mont Cenis low-pressure ammonia synthesis. In February Mr. Scholvien discussed technical phases of the process; this month he goes fully into costs.

OPERATING DATA taken at Mont Cenis plants over long periods of time indicate a maximum hydrogen consumption of 37 cu.ft. of H_2 per pound of NH_3. This consumption is based on a hydrogen temperature of 20 deg. C., inclusive of vapor tension, as well as losses which occur due to leaks and in the transformation of carbon monoxide. A plant having a capacity of 100 tons per day of NH_3 has a total consumption of $37 \times 100 \times 2{,}000 = 7{,}400{,}000$ cu.ft. per day of H_2. Inclusive of losses, the coke-oven plant must furnish 2,230 million B.t.u. per day in the form of H_2. The residual gas coming from the coke-oven-gas separation system (see *Chem. & Met.*, February, 1930, p. 84, Table I) contains 25 per cent more heating value per cubic foot than the coke-oven gas. By regulating the nitrogen content of this gas it is possible to deliver it with 35 per cent more heating value. This gas can be used for heating the coke-oven batteries or for city gas supply. A normal size coke-oven plant is entirely capable of delivering these 2,230 million B.t.u. per day for ammonia synthesis. For example, if a coke-oven plant with a capacity of 1,100 short tons per day of coke is capable of delivering 45 per cent of the heat units contained in the raw gas to the synthetic plant, this 45 per cent amounts to 2,800 million B.t.u. per day. The quantity of hydrogen contained in the total quantity of coke-oven gas of this plant would be sufficient for the production of 100 tons of ammonia per day. In doing this, 2,230 million B.t.u. is removed from the gas per day. The approximate distribution of heat of such a coke-oven plant would be that shown in Table III.

Office and Laboratory Building at the Scholven Plant

Two-Stage Coke-Oven-Gas Compressors Driven With 1,200-Hp. Squirrel-Cage Motors



Therefore, it is possible for a coke-oven plant producing 1,000 tons of coke per day and using 55-50 per cent of its oven-gas production in the manufacture of coke to make 90-100 tons of ammonia per day from the hydrogen contained in the coke-oven gas and still leave a surplus for use as city gas.

Power consumption for a complete low-pressure ammonia synthesis plant, including production of the mixed gases ($N + 3H$), is summarized, in Table IV.

Number of men required to operate a low-pressure synthesis plant consisting of two 47-ton-per-day units includes 31 for sulphur purification, gas holders, pumps and cooling systems, lye regeneration, compressors and

Table III—Approximate Heat Distribution in Gas Plant for 100-Ton Low-Pressure Ammonia Plant

	Million B.t.u.	Per Cent of Total
Raw gas produced in making 1,100 tons coke...	6,200	100
Heating of batteries consumes..................	3,400	55
Gas surplus for ammonia, etc..................	2,800	45
Gas for 100 tons ammonia production..........	2,230	36
Gas available for other distribution*...........	570	9

*Should the coke-oven plant be constructed for blue-gas heating, the gas surplus or other distribution could be raised from 570 to 3,970 million B.t.u.

Table IV—Distribution of Power Consumption per Pound of NH_3 Produced by Low-Pressure Synthesis

	Hp.-Hr. Per Lb. NH_3
Coke-oven gas compression	0.32
Gas and air separation	0.43
Synthesis, including gas compression to 100 atm., gas circulation and compression for refrigeration	0.45
Miscellaneous, including cooling water supply, lye regeneration and ventilation	0.08
Total power at machines	1.28
Total power at mains, motor efficiency, 91 per cent	1.41
Total kw.-hr. per lb. NH_3	1.04

synthesis; this also includes foremen. For gas and air separation 30 men are required. Six operating chemists complete the personnel, giving a total of 67 men per 24 hours. Based on three eight-hour shifts, only 22 men per shift are required to operate the plant.

If such a plant is not connected to a coke plant, a storekeeper, gatekeeper, cleaner, and the like are required, an additional 7 men per 24 hours. The machine shop would require for labor and superintendence 18 men per 24 hours. The workmen required for taking care of the compressors could be further reduced, since one man can readily superintend three compressors. Where plants large enough to use three units can be built, the labor charge will be accordingly reduced. It appears then that for plants consisting of only two units and having a total capacity of 94 tons per day of NH_3, the personnel required is as follows: Operation, 67 men per day; repairs, 18 men per day; miscellaneous, 7 men per day; or a total of 92 men per 24-hour day. Therefore, somewhat more than 1 ton of ammonia is produced for each man working eight hours a day. With a selling price of $100 per ton of NH_3, and wages of $6 per man, the total labor cost is less than 6 per cent. I mention this figure because it shows the small effect that wage differences in various countries have on the production cost. In German plants, for example, one man costs $2.60 per eight hours, thus giving an advantage to the German producer of about 3.4 per cent in selling price.

The figures I have so far obtained covering installation costs of ammonia synthesis plants are so radically different from those applying to the Mont Cenis low-pressure process that the listing in Table V of the installation costs for some of the Mont Cenis plants will be of interest. These figures do not include ground costs and long-distance pipe-line costs. They do, however, include all other costs, such as desulphurization, gas holders, gas and air separation, compressors, synthesis, motors, switching systems, cables, cranes, pumping and cooling

Table V—Installation Costs of Existing Mont Cenis Plants

Plan	Erected	Tons NH_3 Per Year Total Capacity	Complete Installation Cost for Furnishing Anhydrous Liquid NH_3, Dollars	Total Plant Cost, Dollars Per Annual Ton NH_3
Mont Cenis	1926-27	28,000	3,100,000	111
Hibernia	1927-28	37,000	3,100,000	84
Scholven	1929-30	49,000	3,200,000	65

systems, all piping, buildings, foundations, railroad sidings, laboratory, machine shops, erection, royalties, and freights; in other words, all costs incurred up to the moment the plant goes into operation. Of course, the costs for installing similar plants in this country would be higher than those in Europe, due to the higher price scale here. Very thorough comparisons have shown that the cost of putting up such plants would be 55 per cent higher in the United States than in Germany. Of course, the price differences vary in different classes of work and equipment. For processing equipment the cost is about 45 per cent higher here; for buildings, 90-110 per cent higher; for erection, 130 per cent higher. Some parts of the equipment, such as motors, cables, and pipe lines, are about equal to European costs. All these figures give an average of about 55 per cent extra cost in America. Accordingly, the cost for a hydrogen production and synthesis plant similar to the Scholven plant would be about $100 per ton of anhydrous ammonia per year in the United States.

Production Costs

Costs of raw materials, power, labor, maintenance, amortization, and other fixed and supervisory charges can now be evaluated: (1) It may be assumed that the coke-oven plant provides coke-oven gas for the synthesis at the rate of 7.5 cents per 1,000 cu.ft. This is equal to a charge of $3.60 per ton of NH_3. (2) Based on wages in the United States, the charge for labor and repair labor, working three eight-hour shifts, amounts to $6 per ton of NH_3. (3) Power cost for 2,080 kw.-hr. at 0.5 cent per kilowatt-hour is $10.40 per ton of NH_3. (4) Experience gained so far in low-pressure synthesis plants has shown that the cost of maintenance, including all charges, plus the cost of general supervision (salaries of engineers and chemists), is $12 per ton of NH_3. (5) The last item, amortization, due to the long life of low-pressure synthesis plants, is low and may safely be taken

Table VI—Direct Production Costs per Ton NH_3 Produced by Low-Pressure Synthesis

	Dollars Per Ton NH_3	Per Cent
Coke-oven gas at 7½c. per M cu. ft.	3.60	8.0
Wages, U.S. basis and three eight-hour shifts	6.00	13.3
Power, 2,080 kw.-hr. at 0.5c.	10.40	23.1
Maintenance and supervision	12.00	26.7
Amortization	13.00	28.9
Total per ton NH_3	45.00	100.0
Total per lb. NH_3	0.0225	.....

at 13 per cent, or $13 per ton of NH_3. These costs are summarized in Table VI.

Where wages are low, as in the southern part of the United States, with a power cost of 0.4 cent per kilowatt-hour, and where the synthesis plant can be operated in conjunction with an already existing coke plant so as to reduce the capital expense, the production cost may be as low as 2 cents per pound of NH_3. This is approximately the minimum production cost which can be obtained.

For remaining costs of interest on operating capital, insurance and superintendence, a total charge of $5 per ton of NH_3 is equitable. Operating capital on a plant for producing anhydrous ammonia alone is small. Insurance amounts to about 1 per cent per year. Superintendence involves only a small charge, particularly where the ammonia plant is run in conjunction with a coke plant whose organization can take over operation of the ammonia unit. With these final items included, the total production cost per ton of ammonia is not greater than $50.

Costs for the low-pressure synthesis process, as outlined above, differ widely from those made public covering high-pressure synthesis plants. It is unfortunate that it is impossible to go into a comparison of the detailed costs. However, in one published account it is stated authoritatively that the initial capital expense is about equal to the production cost for a period of two years. This would mean a capital expense of $220-240 per annual ton of ammonia capacity. In another article a cost of $250 per ton of annual capacity is said to apply to a plant of 300 tons daily capacity, stated to be the

smallest unit that can be built economically. The statements referred to existing high-pressure plants in the United States and evidently include all equipment for both synthesis and the production of hydrogen from coke water gas. These figures compare with a capital cost of about $100 per annual ton capacity for a Mont Cenis low-pressure plant.

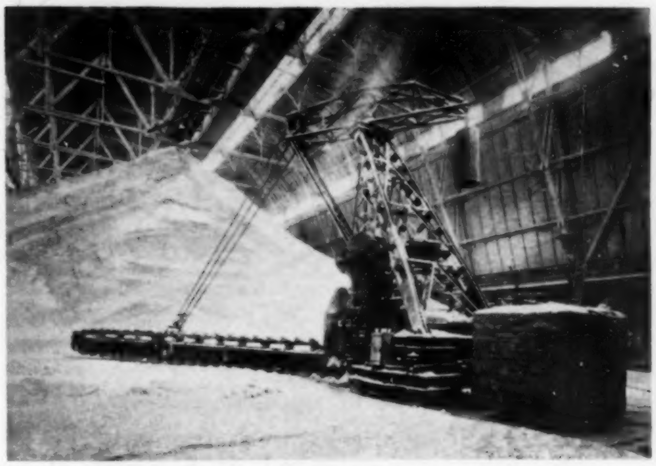
Since misunderstandings are likely to occur in the discussion of initial capital expense, I wish to make the following definition. The building of an ammonia synthesis plant according to the Mont Cenis process naturally begins with the desulphurization of the coke-oven gas and includes everything required to deliver the liquid ammonia in the tank cars. Therefore, the buildings, foundations, and chemical laboratory are included as well as the cost of the Linde plant, which includes compressors, piping, motors, buildings, erection, and licensing fees. Only the real estate and long-distance piping for coke-oven gas and residual gas are excluded from this cost of $100 per ton of NH_3 per year.

General Considerations

In considering the very big plants in Germany, England, and the United States, it must be noted that the main source of hydrogen used is coke water gas. Therefore, considering only the size of the plants, it might appear that in spite of the attractive figures for plant and production costs of the coke-oven gas and low-pressure synthesis method, the economic source of hydrogen is coke water gas. However, at the time when the largest ammonia plants in Germany and England were being built, the Linde gas-separation and low-pressure synthesis processes were still in the early stages of development and could not yet be used for large plants. In 1926 these processes were looked upon with skepticism and I am inclined to say that the low-pressure synthesis process had not yet reached its full development until the last few plants with their large units and low investment capital were built. The development and the use of hydrogen made from coke-oven gas were very rapid. In the year 1930-31, 15.5 per cent to 16.5 per cent of the world production of synthetic ammonia is being made from coke-oven gas.

To my mind, the figures given show that coke-oven gas could be the most economic source for hydrogen in the United States. In the coke water-gas process the big raw-material problem in the synthesis of ammonia is the manufacture of hydrogen. This, however, does not

Five-Stage Nitrogen Compressors in the Hibernia Plant



Fertilizer Storage at the Hibernia Plant

apply where coke-oven gas is used. With a power consumption of about 0.6 kw.-hr. for the compression and separation and B.t.u. consumption amounting to only $3.70 per ton of NH_3, equal to 3.5 per cent of the value of the ammonia, the raw-material problem has become a small one for the manufacture of hydrogen from coke-oven gas. As far as the low-pressure synthesis process is concerned, the total power required for the whole process of hydrogen manufacture and synthesis is only about 1.04 kw.-hr., or 0.502 cents per pound of NH_3, which is less than 10 per cent of the selling price of ammonia. Therefore, the power cost in the production of ammonia also is not a serious problem where coke-oven gas is used.

Those synthesis plants which combine low erection cost with simple operation and a cheap source of hydrogen with a short transmission distance to the consumer will be the ones to operate to the greatest advantage. These same reasons, therefore, bring me to the conclusion that small and medium-size low-pressure synthesis plants using coke-oven gas hydrogen and built at various points in the United States, near consuming markets, will be highly profitable at a production cost of 2.2 cents per pound of NH_3. Even in the event that great reductions in the selling price of ammonia should come about, such plants would still be profitable.

Further, although I have read that the conditions peculiar to the United States make the use of coke-oven gas for hydrogen inadvisable, I have found that in several districts in this country the price of coke-oven gas is considerably lower than the lowest European prices, and I know of districts where the coke plants would be glad to dispose of unpurified coke-oven gas continuously for 7.5 cents per 1,000 cu.ft.

As a final point it is worth noting that low-pressure synthesis plants are easy to put into operation. The average time for starting the first unit is represented by the starting of a 27-ton unit at the Hibernia plant. In this case the total time until the unit was operating at full capacity was nine days. A half day more or less seems to be about the range that can be expected. These excellent showings are possible, of course, because all operating procedures have been standardized.

All in all, the figures that have been given show that the coke-oven gas separation process, coupled with the Mont Cenis low-pressure synthesis, using coke-oven gas hydrogen, can be operated on a very profitable basis in the United States.

LIQUID CO_2—How Technology Has Harnessed the Available Sources

Because the present stand of the CO_2 industry is generally appreciated only in "shreds and patches," Dr. Reich has consented to prepare this survey of its technical methods and problems. Confining himself to the liquid product in the ensuing pages, he will present a similar study of solid CO_2 in a subsequent issue.

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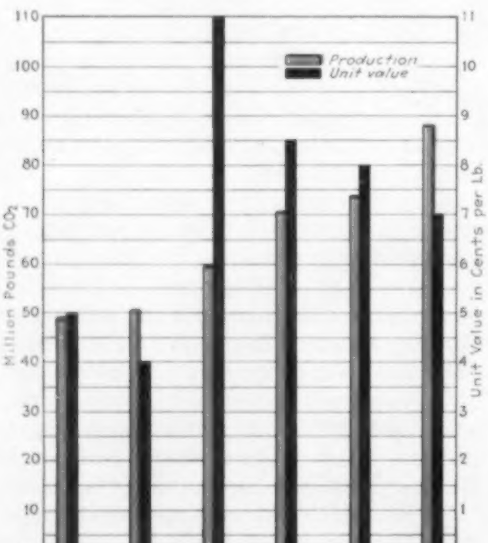
BEFORE 1922 the sources of carbon dioxide and the methods of production were considered standardized. Since the introduction of solid CO_2, nowever, new sources of supply have been exploited and new methods of purification have been developed. The gas is almost 50 per cent heavier than air, is nearly odorless, non-explosive, and non-poisonous, and can be found and produced in unlimited quantities. It serves as raw material for the liquid and solid forms. Its growth in liquid form compares very favorably with other gases as shown below:

Year	Number of Establishments	Total Pounds as Liquid CO_2	Value
1909	35	47,955,291	$2,345,743
1914	38	50,445,779	2,320,685
1919	42	59,771,401	6,574,250
1925	..	70,466,801	6,001,424
1927	..	74,344,287	6,048,424
1929	48	88,186,356	6,280,647

This table does not take into consideration the large quantities of liquid carbon dioxide produced for conversion into solid form, which will be discussed in a succeeding article. Likewise Fig. 1 shows the production and unit value of liquid CO_2 in successive years. During the last ten years, the production increased 83.9 per cent and the unit value of the product decreased 36.36 per cent. The number of establishments increased only 12.3 per cent, while the income derived from its sale has been almost constant. The slight increase of establishments was contributed mainly by the distilleries, which obtain CO_2 as byproduct from fermentation of molasses. The slow increase is attributed to the surplus capacity of existing plants and to the large investment required for cylinders and equipment.

Fig. 1—Unit Value and Production of Liquid CO_2 in Past Years



There are 48 plants producing liquid CO_2, as follows: Nine using gas produced as a distillery byproduct from the fermentation of molasses, or grain; two by decomposition of magnesite by an inorganic acid; three by collection from natural springs; thirty-four by thermal decomposition of carbonates, or by burning coke. The yield and purity of CO_2 obtained from different raw materials varies greatly. A comparison is shown in Table I.

According to the processing the purity of carbon dioxide changes. Some materials, such as magnesite, yield carbon dioxide by three different methods. However, as Jones (*Chem. & Met.*, Vol. 37, 416-7, 1930) brings out, the usability of any process is affected more by market conditions and cost of power and fuel than by the source of the raw materials. Regardless of which raw material is used, the CO_2 to be liquefied must have a purity of 99.7 per cent. Many raw materials are unable to yield a gas of purity above 40 per cent CO_2; therefore methods have to be employed which yield a gas of high purity. We may thus divide the various processes required for the concentration, or purification, of CO_2 into two groups: One is for gases containing less than 40 per cent and the other for 99.7-100 per cent CO_2 contaminated with slight impurities. In either case special equipment is required, which would vary according to the source of raw material being used. We have several methods for the recovery of carbon dioxide of low concentration, such as the Suerth system, but in America 70 per cent of the producing plants are using the absorption system.

In processes where air is required to maintain combustion and a gas is produced with insufficient CO_2 content for straight liquefaction, the method applied exclusively for the recovery of CO_2 is the absorption system. Whatever may be the source of raw material,

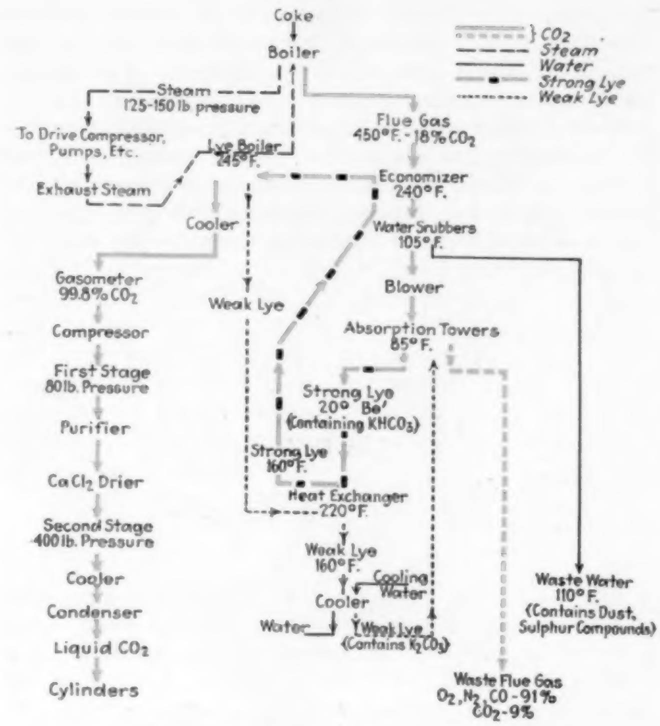


Fig. 2—Flow Diagram of Absorption System

the system is applicable to all. However, the greatest mistake made by many is that, taking for granted an ample supply of CO_2, its recovery is simple and profitable. The main point to be considered, when the absorption system is to be used, is that considerable power is required for the operation of the various machines, such as compressors, pumps, blowers, and fan. In some instances the disposal of the residue, also, enters into the problem. Sometimes it is advisable not to produce a completely burnt limestone and dolomite; then the disposal of burnt lime for fertilizer purposes must, also, be considered.

Absorption Process

Carbon dioxide to be treated in the absorption system may be obtained through the following sources: (1) Thermal decomposition of limestone, dolomite, magnesite, marble; (2) carbonization of coal; (3) combustion of carbonaceous material; (4) sulphite liquor. The description of the absorption system that follows will assume coke as the raw material. When limestone, or dolomite, serves as a raw material, in order to effect fuel economy, they are mixed in a proportion of approximately 220–240 lb. of coke for every ton of limestone burned.

Coke used for this system should be capable of easy handling without disintegration. A 48-, or preferably a 72-hour foundry coke usually is used; sometimes a combination of both where a reduction of cost is practical. Its sulphur and ash content should be low, the former causing the formation of undesirable sulphur compounds and the latter clinkering, because of the high temperature carried in the furnace. The use of soft coke is advisable only in exceptional cases, as the large quantity of dust carried over with the flue gases, sometimes hydrocarbon impurities, makes its purification and recovery uneconomical.

The coke is burned under specially designed boilers. Here the heat given off serves for the generation of steam as a motive power for all the machinery, and the flue gases yield the CO_2. The furnace design must be such that the air necessary for complete combustion can be regulated easily to prevent air infiltration and dilution of the carbon dioxide. The furnace is lined with high-temperature firebrick, sometimes carborundum, to withstand the high temperature which an efficient operation demands. Combustion is carefully controlled by the utilization of recorder and draft gages. The flue gases obtained by careful combustion contain 17–18 per cent CO_2. Such a high concentration of CO_2 requires the control of fire in a manner that the free oxygen shall not exceed 2.5 per cent. Approximately, 10 cu.ft. of air at 15 deg. C. is required per pound of coke. The flue gases will contain 18 per cent CO_2, oxygen, some carbon monoxide, nitrogen, sulphur compounds, organic matter, and dust. Besides furnace design, regulation of air, and quality of coke, the manufacturer has also another means for insuring a high concentration of CO_2; namely, by regulating the depth of fuel bed. In well-conducted plants, it averages 16 to 18 in., and when the secondary air passed over its surface is regulated properly, a flue gas with a CO-content as low as 0.75 per cent is obtainable.

As shown in Fig. 2, coke serves two purposes: for the production of CO_2 obtainable from its flue gases, and then for the production of steam at 125–150 lb. pressure in burning underneath the boilers. The stack, in Fig. 3, is provided with dampers which permit the discharge of low-purity flue gases into the atmosphere and which are closed when its recovery is desired. The flue gas coming from the boilers is purified in three stages: removal of sulphur compounds and dust; removal of all other gaseous impurities; and, in some instances, removal of organic matter and moisture.

For removal of sulphur compounds and dust, so-called "water scrubbers" are being used. They may be built out of wood, iron, or iron tanks lined with concrete to resist the corrosive action of the impurities. The tanks are provided with perforated bottoms, or grids, which support the limestone packing. The gas is thoroughly

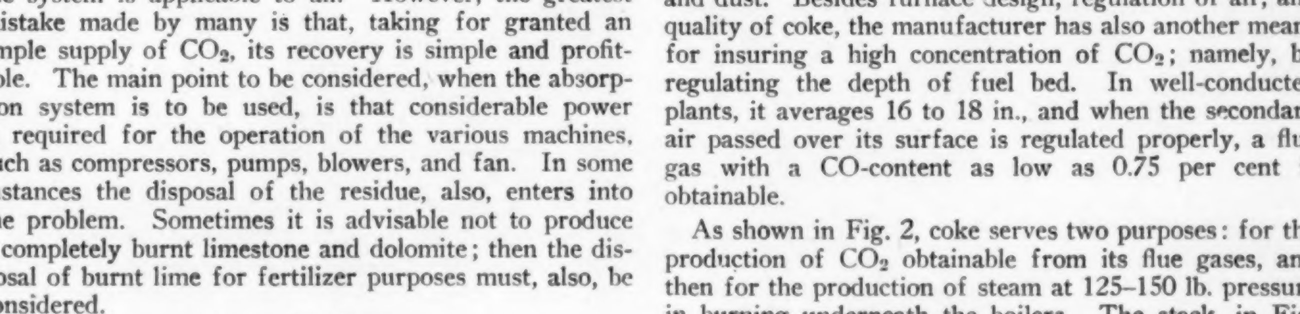


Fig. 3—Standard CO_2-Absorption System

Fig. 4—Absorption System With Lye Boiler on Left

washed in this scrubber—usually two are in use—before it enters the absorption towers. The scrubbing medium is water. The flue gas, which in some instances may pass through an economizer before it enters the water scrubbers, is drawn by a fan placed between the scrubbers and the absorption towers in counter-current direction. The water, which for economical reasons is taken from the coolers, trickles over the limerock, where it absorbs the sulphur compounds and also removes the dust. The limestone serves as a tower filler and reacts with the sulphur compounds to form a water-soluble product which is carried into the sewer.

As the water, besides being the scrubbing medium, also cools the hot flue gas, its temperature on entering and leaving the scrubbers must be controlled carefully. In practice, it enters the scrubbers at approximately 85 deg. F. and leaves at 105–110 deg. The flue gas enters the scrubbers around 250 deg. F. and passes into the absorber at a temperature of 85 deg.

The second step of this process consists of the removal of gaseous impurities such as oxygen, carbon monoxide, and nitrogen, which are present in a ratio of one part CO_2 to 4.6 parts of impurities. The removal is accomplished by means of an alkali carbonate solution in the absorption towers. Either potassium carbonate or sodium carbonate is used for this purpose. Because of their different solubilities in water in their form as carbonate and bicarbonate, the solution containing sodium carbonate has a lower concentration than the potassium carbonate solution. Both are called "lyes"; the former has a density of 16 deg. Bé. and potash lye has a density of 20 deg.

The sulphur- and dust-free CO_2 is drawn by a blower from the water scrubbers and is forced into the absorption towers, usually two in series. The dimensions of these towers, for a five-ton daily liquid plant, are 9 ft. in diameter and 50 ft. high; a 10-ton plant requires towers 12 ft. in diameter and 55 ft. high. The towers contain grids which support 2x3 in., 72-hour hard-burned foundry coke and are provided with a few liquid distributing plates.

The carbon dioxide is led into the bottom of the absorption towers and liquid is circulated in counter-current principle, absorbing part of the carbon dioxide and the unabsorbed gas with other insoluble gases passes into the atmosphere (percentages as shown in Fig. 3). The solution entering the towers is called "weak lye," but after absorbing part of the CO_2, it is called "strong lye." Pumps are circulating the liquor through the towers and are delivering the "strong lye" first into the heat exchanger. The temperature at which the towers are operating should not exceed 115 deg. F. When sodium carbonate (Na_2CO_3) is the absorbent, the solution contains 7.5—8 lb., and when potassium carbonate is present, 12.3 lb. per cubic foot. For every 1,000 lb. of CO_2 per hour produced, approximately 120 gal. per minute of sodium carbonate lye is required. The flue gas gives up its CO_2 up to about 9 per cent, which can be recovered under pressure requiring a great deal of power.

Chemically, the absorption system consists of two reactions: First, the alkali carbonate is converted into bicarbonate in the absorption towers, and then is reconverted in the lye boiler, liberating the absorbed gas:

Absorption Towers

$$\text{(1)}\quad \underset{106\text{ lb.}}{\overset{\text{Weak Lye}}{Na_2CO_3}} + \underset{18\text{ lb.}}{H_2O} + \underset{44\text{ lb.}}{CO_2} = \underset{168\text{ lb.}}{\overset{\text{Strong Lye}}{2\ NaHCO_3}}$$

Lye Boiler

$$\text{(2)}\quad \underset{168\text{ lb.}}{\overset{\text{Strong Lye}}{2\,NaHCO_3}} + \text{Heat} = Na_2CO_3 + H_2O + \underset{44\text{ lb.}}{\overset{\text{Weak Lye}}{CO_2}}$$

The cold strong lye passes first through the inner pipe of a double-pipe heat exchanger and the hot weak liquor entering at 220 deg. F. travels in the annular space between the pipes and gives up part of its heat to the strong lye. The preheated strong lye then goes to the economizer or in some instances direct to the lye boiler. The utility of the economizer is sometimes doubted, as the gain made by the recovery of part of the heat from the flue gas is offset by the collection of soot and other difficulties which are encountered with apparatus utilizing waste heat. The economizer consists of a shell and is provided with steel tubes of sufficient diameter to permit an easy travel of the flue gas. Outside the tubes the strong lye travels, cooling the flue gas from 450 to 250 deg. F.

The preheated strong lye now enters the lye boiler, a cylindrical drum provided with steam coils and heated with exhaust steam coming from the compressor, pumps, and so on. Sometimes live steam is used when electric current serves for driving the various equipment. The pressure of the exhaust steam is around 15–20 lb. Lye boilers are also heated direct by burning coke in the furnace. Which method is the most economical depends on the cost of fuel and power, as the utilization of high-pressure steam may offset any benefit derived from other sources. The strong lye flowing continuously from the

Table 1—Purity and Yield of Carbon Dioxide From Various Raw Materials

Raw Material	Chemical Formula	Content Per Cent CO_2	Purity of Gas Per Cent CO_2	Yield in Lb. Liquid CO_2 per Ton Raw Material	Per Cent of Theoretica CO_2 Recoverable
Wood	$(C_6H_{10}O_5)x$	..	14	....	....
Coke	C	..	18	1540 2350	34.0 47.0
Potassium Carbonate	K_2CO_3	32	99–100	608	95.0
Sodium Carbonate	Na_2CO_3	41	99–100	780	95.0
Potassium Bicarbonate	$KHCO_3$	44	99–100	836	95.0
Limestone—98%[1]	$CaCO_3$	44	38	672	76.4
Dolomite—95% (1)	$CaCO_3$ $MgCO_3$	48	40	744	77.5
Magnesite (1)	$MgCO_3$	51	40	790	77.5
Magnesite (2, 3)	....	52	99.5	900	86.5
Sodium Bicarbonate	$NaHCO_3$	52	99.5–100	1040	95.0
Molasses (4)	$C_6H_{12}O_6$ $C_{12}H_{22}O_{11}$	..	99.5–100	420	84.0
Corn[5]	$(C_6H_{10}O_5)x$	..	99.5–100	558	84.0
Corn (6)	$(C_6H_{10}O_5)x$	..	60	...	....
Potatoes	$(C_6H_{10}O_5)x$	..	99–100	138	84

(1). Yields apply to limestone, dolomite, or magnesite; coke added for the decomposition is omitted.

(2). Calcined in closed retorts.

(3). Treated with a mineral acid.

(4). One ton of molasses = 168 gal. and contains 50 per cent sugar

(5). One ton of corn = 35.7 bu. used for the production of ethyl alcohol.

(6). One ton of corn used for the production of butanol.

heat exchanger, or economizer, into the lye boiler is heated to 245 deg. F. The gas liberated (as in Equation 2) generates 8–10 lb. pressure per square inch and forces the weak lye through the heat exchanger and the CO_2 first through the analyzer, which is part of the lye boiler and consists either of plates arranged with downtake pipes or filled with coke. The escaping gas of high purity preheats the strong lye entering the analyzer and then passes through the water cooler into the gasometer. The cooling coils are long parallel lengths of pipe connected to form a continuous pipe. The gas, heated to a high temperature, is saturated with water and, as it passes through the cooler, the moisture is condensed and is returned to the weak lye, in order to maintain its proper concentration. From the gasometer the gas is led to the compressor, which will be discussed later.

This general description of the absorption system shows that success depends on the highest concentration of flue gas, absorption of CO_2 per cubic foot of lye, and maximum dissociation of the alkali carbonate solution. The total power required in an absorption plant per ton of liquid CO_2 produced is approximately 25 hp. and the coke consumption is 0.85–1.25 lb. per pound of liquid gas.

Lately, another absorbent has been brought on the market, called triethanolamine (manufactured by the Carbide & Carbon Chemicals Corporation). Since this material, a tri-hydroxy ethyl substitution product of ammonia, is alkaline, its reaction with acid is almost quantitative. With carbon dioxide it is as follows:

$$\underset{\text{Triethanolamine}}{2\,N(C_2H_4OH)_3} + \underset{\text{water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2} = \underset{\text{Triethanolamine carbonate}}{(N\,(C_2H_4OH)_3H)_2\,CO_3}$$

Its use is similar to that of alkali carbonate, being circulated by a pump through the absorption tower. Theoretically, 6.77 lb. of triethanolamine can absorb one lb. of CO_2 and one volume can release 90 volumes of CO_2 at 20 deg. C. at atmospheric pressure. A solution with 50–60 per cent triethanolamine gave very good results at a temperature between 20 and 25 deg. C. The product being new and the price quite high, further development will have to be awaited before definite conclusions can be drawn.

Fermentation Sources

A very large source of carbon dioxide is the fermentation industry, where it is obtained by the action of yeast or bacteria on molasses, corn, or similar products. If yeast is used, alcohol and carbon dioxide are produced; while other micro-organisms generate solvents and a gaseous mixture of hydrogen and CO_2. The yield of CO_2 per pound of raw material depends on the mode of fermentation. From starchy material, such as corn, we may obtain per bushel 2½ gal. of 190 deg. ethyl alcohol and 17 lb. of CO_2, or 13 lb. of solvents and a gaseous mixture consisting of 40 per cent hydrogen and 60 per cent CO_2 by volume. The same ratio applies when saccharine material, such as molasses, is being fermented.

Recovery and purification of CO_2 obtained by fermentation processes differ greatly from the adsorption system, being obtained at a temperature seldom exceeding 105 deg. F., so that no special cooling arrangements have to be provided and the CO_2 content is either 60 or above 99.5 per cent.

For the recovery of fermentation gas hermetically sealed fermenters are almost entirely being used. If they are wood, either flat wooden covers are provided and bolted to the bottom to give greater strength, or ribbed steel covers are placed in a trough sealed with paraffin. If iron fermenters, or covers, are in use, they are provided with dome-shaped covers, as in Fig. 6, which permit a quick removal of the air from the fermenters, whereby a purer and higher yield of CO_2 per gallon of mash is obtainable. The fermenters usually are operated under a slight back pressure, thus preventing air infiltration and diluting gas. It can be maintained by a pressure release valve, bell-shaped arrangement, or by means of pressure regulating arrangements, as in Fig. 8. Another advantage of hermetically sealed fermenters is that the yield of alcohol is increased at least one per cent.

Fermentation CO_2 has a high purity, but its odorous contamination requires careful removal, as the slightest odor present in the gas may impart a very unpleasant taste, or odor, to the carbonated beverages for which it is used. A description of three purification systems will now be given.

Backhaus Process

As shown in Fig. 6, the CO_2 coming from the fermenters, before its purification, is collected in a gasometer having a capacity of 50,000 cu.ft. From there, positive Root blowers force the gas through cast iron Feld scrubbers, each consisting of nine chambers. The opening in the bottom of each chamber acts as a passage for the ascending gas as well as for an overflow for the counter-current flow of scrubbing liquid. A vertical shaft is suspended in each chamber with a series of concentric frustra of cones. Water is circulated through these scrubbers to remove part of the impurities carried in the gas. The same blower forces the CO_2 afterward through the carbon purifiers. They are cylindrical vessels, 3.5 ft. in diameter and 13 ft. high, and consist of chambers which are provided with perforated plates through which U-shaped tubes pass. The tubes are surrounded with distributing bonnets and the activated carbon is packed about the tubes. Each compartment requires approximately 2,200 lb. of carbon, and four of these compartments are sufficient for the purification of approximately 100,000 lb. of CO_2 per month.

The carbon is then revivified by passing low-pressure steam through the carbon and circulating high-pressure steam through the tubes. The steaming is continued until all absorbed impurities are driven out, followed with dry air, which is blown through the carbon for the removal of moisture, and during the drying the heat is maintained on the coils. While one set is in use, the other is

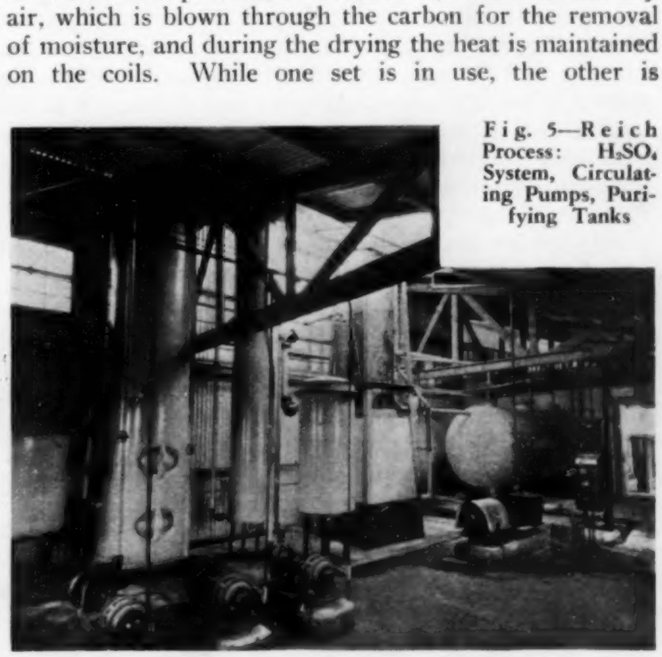


Fig. 5—Reich Process: H_2SO_4 System, Circulating Pumps, Purifying Tanks

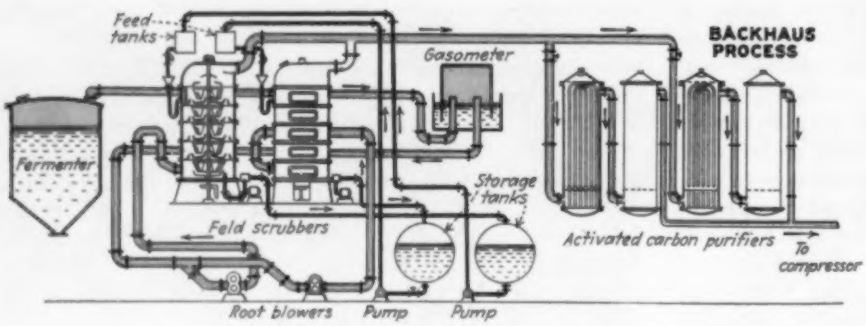


Fig. 6—Backhaus System of CO_2 Purification

revivified. The scrubbing of the gas previous to its passage through the purifier has a beneficial effect, as it cools the CO_2 before entering it and the carbon is cooled by circulating water through the coils while the gas passes through the purifier. From the purifier the gas goes to the compressors, which have a capacity of 600 lb. of CO_2 per hour.

Silica Gel Process

While the Silica Gel purification and drying properties are well known, it took several years before it could get a foothold in the fermentation industry. The general arrangement of this process is shown in Fig. 7. In this process Silica Gel is being used. Its function is similar to activated charcoal and its action is attributed to capillary attraction.

As in every fermentation process, the gas must be collected and scrubbed of some of its impurities in water scrubbers before it can pass through the activated material. We find that processes using activated material for purification sometimes require in addition an oxidizing agent such as potassium permanganate, or a dehydrating agent such as calcium chloride.

A Silica Gel purification system consists of two pressure-type purifiers, an activator and a Silica Gel trap. This equipment is placed next to the compressor between the first and second stages and is operated under a pressure of about 80 lb. The purifiers are connected in parallel and are provided with a perforated bottom on which is resting the Silica Gel. The CO_2 passes through this and gives up its impurities, also moisture, during its passage. As with activated carbon, the saturation point of the adsorber being predetermined, it is cut off and the gas line and the gas valve of the second adsorber are opened when the saturation point is reached. For the reactivation of the silica gel, heat is applied sufficiently high to drive out all the water, also volatile odorous impurities absorbed from the CO_2 during its passage. A heater and a motor-driven blower are provided, which supply the hot air for activation. Afterward, it is cooled and ready for the adsorption of more impurities.

Reich Process

While the previous processes purify by adsorption, this process, shown in Fig. 8, consists of the oxidation of organic impurities and dehydration by means of chemicals in liquid form. The CO_2 coming from the fermenters is forced under its own pressure through a small pressure-regulating tank, which maintains a constant back pressure of approximately 18 in. and serves also as a catch-all for the entrained beer. From there the gas passes through three scrubbers containing stoneware spiral rings and under its own pressure to the gasometer. The first scrubber contains a weak alcoholic solution, which acts as a preliminary purifier and removes most of the alcohol carried in the gas. The next two scrubbers, in which the scrubbing medium is de-aerated water (the latter being also supplied to the first scrubber), remove almost all water-soluble impurities. The scrubbing liquid is pumped either to the still or fermenters for the recovery of alcohol. The partly purified gas is collected in a gasometer, which is provided with a bypass, both of which are connected to a pump or to an automatic valve, releasing surplus gas into the atmosphere. Up to this point all fermentation-purification processes resort to the scrubbing of carbon dioxide with water.

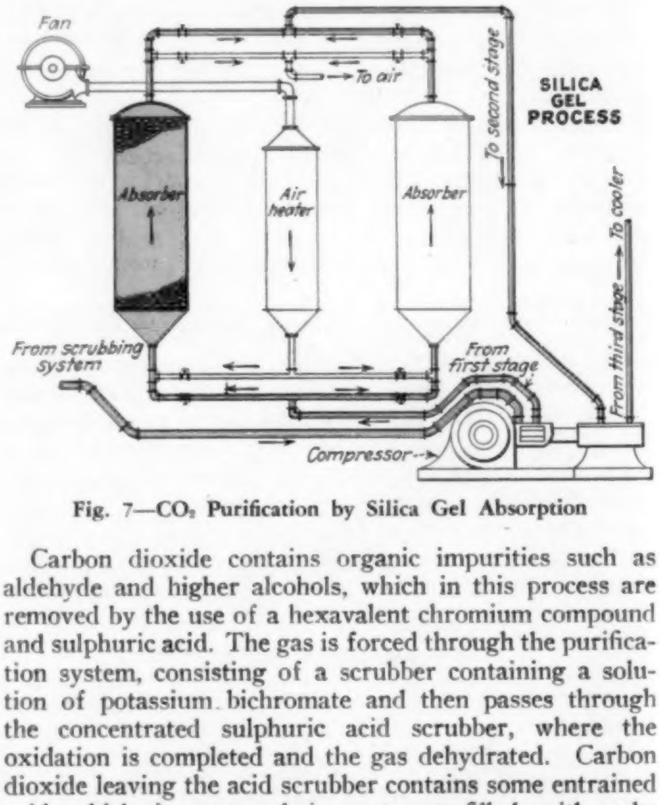
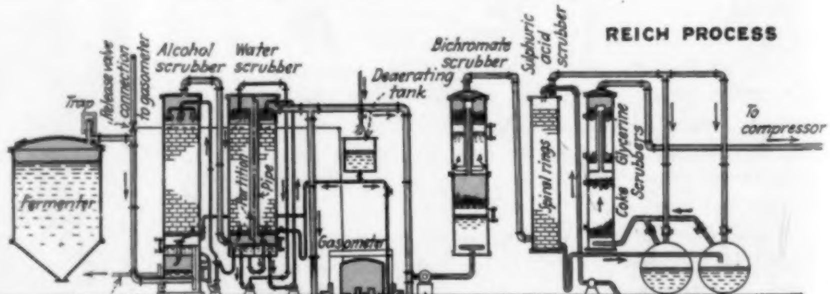


Fig. 7—CO_2 Purification by Silica Gel Absorption

Carbon dioxide contains organic impurities such as aldehyde and higher alcohols, which in this process are removed by the use of a hexavalent chromium compound and sulphuric acid. The gas is forced through the purification system, consisting of a scrubber containing a solution of potassium bichromate and then passes through the concentrated sulphuric acid scrubber, where the oxidation is completed and the gas dehydrated. Carbon dioxide leaving the acid scrubber contains some entrained acid which is removed in a tower filled with coke saturated with sodium carbonate, where, on neutralizing the acid, carbon dioxide is liberated. Before going to the compressor, the gas passes through a scrubber containing a small quantity of glycerine, which absorbs the

Fig. 8—Reich System of CO_2 Purification



oxidation products and delivers an odorless gas to the compressor.

Sulphuric acid, after being used for deodorization purposes, is pumped to the distillery, where it serves for the inversion of sucrose in molasses. About 100 lb. of potassium bichromate and one gallon of glycerine per 100,000 lb. of liquid CO_2 produced are further required.

Natural Springs and Magnesite

To complete the description of the processes used for the manufacture of CO_2, it is now necessary to consider plants where it is recovered from natural springs and from magnesite. In America, three plants produce carbon dioxide from natural springs. They either use an absorption system or compress it direct after the usual treatment with potassium permanganate and calcium chloride.

Magnesite yields CO_2 by three methods. When burned with coke, the absorption system is used. When heated in a closed retort to a temperature of 1,300–1,500 deg. F., its recovery is very simple; however, the cost of the recovery and destruction of the equipment is much greater than in the other two methods. The third method is the treatment of finely ground magnesite in lead-lined containers with sulphuric acid. The liberated gas is freed of its entrained acid and other impurities, collected in the gasometer, and compressed. The magnesium sulphate in solution formed by the action of the acid upon the magnesite is concentrated, crystallized, dried, and brought upon the market as Epsom salt. So far as I am aware, two plants are recovering carbon dioxide according to the last method.

Compressing and Liquefaction

Regardless of which method is used for the concentration or purification of CO_2, the completely deodorized gas is led to the compressor. The compressor consists of three stages: in the first stage, the gas is compressed to about 80 lb.; in the second, to 400 lb.; and the third to 900 lb. In some instances, the purification system is placed between the first and second stages, and may consist of a scrubber containing potassium permanganate for the oxidation of organic impurities, and the second scrubber contains fused calcium chloride for dehydration purposes. Sometimes the latter is replaced with a dehydrator, being cooled sufficiently low, whereby dry CO_2 is obtained. The solid CO_2 and refrigeration plants prefer the latter method.

During compression, care must be taken to have very good cooling. The gas leaving the compressor is above its critical temperature, which is 88.43 deg. F.; therefore it passes first into the cooler, then into the liquefier which is connected with the filling stand. For the compressor, two kinds of lubricants are used; one is a mineral oil called double seamer oil, Nujol, etc., while the other is glycerine. The latter is preferably used with the liquefaction of fermentation gas. Operation of the compressor has to be watched carefully, as the slightest overheating may cause decomposition of the lubricating oil, thereby imparting a very undesirable odor, or taste, to the gas. If mineral oil is being used, it may impart a so-called kerosene odor, while with glycerine, acrolein is formed. So in order that the gas shall come in contact with only fresh lubricating oil, traps are placed in convenient places and lines blown out frequently, which also prevents entrainment of oil into the cooling coils and from these into the cylinders.

Before it is charged into the cylinder, the liquid CO_2 has a purity of at least 99.7 per cent; the moisture content will not exceed 0.1 per cent and will be free of organic impurities and of all acids that are capable of reducing alkaline strength of a 0.1 N sodium carbonate solution.

The filling stand consists of an arrangement of valves and dial platform scales. The valves are so connected that the gas, either from the line or from the cylinder, can be released into the air. This is essential, as the cylinders, before filling, may contain air, in which case the filling is impossible. For the storage of the liquid, 20- and 50-lb. cylinders are being used, which are steamed before every shipment.

The commercial use of liquid CO_2 is very extensive, as shown in the flow sheet by Jones (*Chem. & Met. 29*, 103-5, 1923), and Quinn (*J. Chem. Education.*, Vol. 7). Its greatest use is in the manufacture of carbonated beverages, refrigeration, for the manufacture of solid CO_2, fire extinguishers, urea, and so on. Other uses recommended are for the extraction of logwood (*Chem. Age,* 1904, 217); drying fruit and vegetables (B. S. Harrison, U. S. Patent 1,387,710), carbonated ice cream (M. J. Ingle, U. S. Patent 1,397,168), blasting with liquid CO_2 (Ferrel, Helmholtz, and Crawford, U. S. Patent 1,610,274), carbonation of butter (Prucha, Brannon, and Ruche *J. Dairy Sci.* 8, 318, 1925), process for curing cord tires and molded tubes (Minor, *Ind. Eng. Chem.*, 1928, 291). The Union Carbide & Carbon Company markets, under the name of "Carboxide," a fumigant for foodstuffs consisting of 90 per cent CO_2 and 10 per cent ethylene oxide.

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Phosphate Prospects In Russia

ALTHOUGH apatite has never been an important source of phosphate, small quantities obtained in Canada and Norway have been used in chemical industry and for pure phosphoric acid. In a survey by the Soviet Academy of Science of the ore resources of the Kola Peninsula (in the extreme Northwest of Russia), the presence of large quantities of apatite incited the formation of an official trust for their exploitation. These deposits are found throughout mountainous tundras rich in water power and forests, but very severe in climate.

Actual work began in January, 1930, on a program which specified a production of 250,000 metric tons of ore for 1930 and 1,000,000 tons for 1931. Later, a flotation factory for 250,000 tons of concentrates was begun, and in October a hydro-electric power station for 25,000 kw. went into construction, to be completed in 1932. For transportation, a network of lines was built to feed into the main railway running to Leningrad.

It is estimated that phosphate from the Kola deposits can be delivered in Leningrad at a lower cost than from Morocco. A process has already been devised for extraction of pure apatite from the nephelite with which it occurs. The latter, like apatite, is being studied for the utilization of its three main constituents: soluble alkalis, silica, and alumina. The apatite has an average content of 33.44 per cent P_2O_5. The Five Year Plan calls for a consumption of 7,150,000 tons of soluble phosphate in 1933, of which the Kola Peninsula is expected to supply 1,500,000 metric tons.

Economy in Selection and Design of Chemical Stoneware

Chemical stoneware piping in the cell room of Westvaco Chlorine Products Company

By J. M. W. CHAMBERLAIN

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SOME HUNDREDS of years have rolled by since the first chemical stoneware took shape in the laboratories of the alchemists. Even then it was observed that vessels made from certain clays were much longer-lived than others. Since those early days, constant development has taken place until there are now available types of chemical stoneware suitable for use with practically every corrosive fluid. Today it is frequently true that stoneware is both the best and the most economical material for a particular application; yet there is a dearth of practical engineering information generally available, and this lack, combined with a misunderstanding of the limitations of stoneware, has often prevented its use where it is clearly indicated by the facts of the case.

First it should be definitely understood that chemical stoneware is not common pottery; nothing could be farther from the truth. It is, as is electrical porcelain, one of the most highly technical of ceramic products and one that requires specialized treatment and a high degree of skill in its manufacture. Chemical stoneware is always best when designed for the specific service for which it is intended. To attempt to use common stoneware or common pottery for the average chemical process is to invite premature failure and economic waste.

A HASTY glance at the process by which chemical ware is made will aid in forming a picture of the material. The skeleton outline of its manufacture resembles that of many other clay products. The raw clays are compounded, plasticized, formed, air-dried, and burned. Each phase, however, requires a special technique. One clay body will not successfully make all types of chemical ware. Approximately 15 different bodies, each having several possible variations, are necessary. These differ as to raw clays, grogs (ground siliceous material), feldspars, quartz, and a variety of chemicals, all of which must be blended in order that the desired physical, thermal, and chemically resistant properties may be given to the finished product.

Generally the clay is plasticized in a mill with the aid of water and various oxidizing agents. The amount and method of milling depend on the body being prepared. In many cases, the raw clays must be thoroughly washed and filtered, thus removing certain undesirable materials. On the other hand, other ingredients are lost in the washing and must be replaced in controlled quantities. The plasticizing of the mix is promoted by aging. This process brings on a bacterial growth which toughens the green clay and facilitates manufacture. After clay has been aged for a number of months, it is retempered by a second milling, in order to assure uniformity of texture and to condition it for fabrication. Prior to manufacture, the green clay mix must be rubbed to remove included air which otherwise would cause fissures in the body of the finished piece.

AFTER the air has been worked out, the ware is formed by one of three general methods including: pressing, molding, and turning; or a combination of these. The first two methods require special mold or die equipment for each type and size of article produced. Molds are made of plaster of paris, which absorbs moisture from the damp clay placed in the mold. This loss of moisture is accompanied by shrinkage of the piece, freeing it from the mold. In machine pressing, the green clay is extruded through a press die. As in the case of dies for most other purposes, their expense prohibits their use for odd shapes not made in quantity.

Turning of ware may be accomplished either with or without the use of molds. In either case, the clay is placed on a revolving wheel and is drawn into shape by mechanical means or by hand. Great skill is required in fabrication to assure a solid piece of ware, free from flaws and crevices.

After forming, the green ware must be dried and annealed. It is this stage which materially affects the time of manufacture. One article can be dried very quickly in a hot-blast drying compartment under conditions of controlled humidity and temperature while another larger and more complicated piece may require four to six weeks' drying. It is important that internal strains be relieved in every piece. If this is not done properly, failure will occur or the finished product may not possess the desired physical properties.

Shrinkage occurs during this drying and annealing stage. This is due in part to evaporation of hydroscopic water and in part to the loss of a portion of the combined water. Other chemical changes also materially affect the contraction of the clay. So many variables enter into the shrinkage that it is impossible technically to control all of them. This fact is aggravated by the number of odd and different shapes that must be made in small quantities by hand. Losses are many in the

drying stage, due to shrinkage cracks, warpage, and disfiguring of the article. It is for this reason that apparatus made to close dimensional limits sells at a higher price. Articles of a standard type, made on a production scale, fare much better during the drying than do the special shapes, because in the former case the majority of variables have been worked out and are kept under control.

Were it not for the fact that chemical stoneware can be readily worked and machined, it would be impossible to make many of the complicated precision articles now produced. Stoneware parts can be ground to a tolerance of $\pm$ 0.0001 in., thus making possible the production of such machinery as centrifugal acid pumps, exhausters, valves, electric tumbler mixers, jar mills, ball mills, etching machinery, and other revolving equipment. Mechanical efficiency of such equipment is high and the equipment is very durable.

After drying, the ware may either be fired directly or slip-glazed and then fired. Firing is accomplished in round down-draft kilns of the beehive type. Kilns are fired slowly at first to remove any free moisture still present in the ware. After several days, a temperature of 2,300 to 2,800 deg. F. is reached. The final temperature depends on the characteristics of the ware. When a suitable end temperature has been attained, the ware is allowed to cool for several days in the closed kiln. This slow cooling avoids any undue temperature gradient in the body of the ware which might cause cracking.

Chemically, the firing operation consists of a series of non-reversible endothermic and exothermic reactions which in their finality lead to a vitrified mass. The final temperature is the one which will yield the proper degree of vitrification for the type of article being made. Variations in vitrification are possible in the same kiln by taking advantage of the temperature gradient existing between the top and bottom of the kiln.

Three kinds of external finish may, in general, be applied to chemical ware. It may be burned without glaze, it may be slip-glazed, or it may be salt-glazed. The finish selected depends on the conditions under which the article is to be used. It should, however, be borne in mind that the glaze on high-quality ware serves but two purposes: to improve the appearance of the ware, and to facilitate its cleansing by lowering surface adhesion. The belief that the glaze renders the body of the ware acid-proof is entirely erroneous. Any well-made chemical stoneware is non-porous and acid-proof, either with or without the glaze.

FEW engineers appreciate the range of properties that are obtainable in the various chemical ware bodies. Although the selection of bodies having proper physical and thermal characteristics must, for the most part, be left to the chemical ware manufacturer, it should be realized that a possible variation of from 100 to 300 or even 400 per cent in certain of the physical properties is entirely possible. Because of this great variety, it cannot be too strongly urged that the prospective user supply the manufacturer with all possible information. This should include the fluid or fluids to be handled; complete thermal data in regard to maximum and minimum temperatures and rate of temperature change; heat transfer characteristics desired; whether or not the fluid contains abrasive material; what mechanical loading strains are to be encountered and, finally, whether certain physical or thermal properties are to be accentuated. The usual conditions under which standard apparatus is used are well understood by chemical ware manufacturers. In the case of special apparatus, however, it is important that as much specific information as possible be given.

Another case where co-operation between the user and the maker is highly desirable is in the matter of the application of standard sizes and shapes. Many of the larger users of chemical ware have in the past designed types to meet their own requirements. This has brought about a tremendous variety of equipment and has made difficult the attempts of chemical ware manufacturers to standardize on a minimum number of shapes and sizes. Obviously, standardization is very desirable. Since molds and dies for these standardized items are already in the possession of the manufacturers, the selling price of such articles is lower and the delivery time less. There are, of course, many cases where new apparatus must be designed, but it is frequently true that standard apparatus will serve equally as well as special designs evolved in the engineering department of the user.

ANOTHER money-saving angle in selecting stoneware is the use of an equivalent number of smaller pieces rather than a single larger piece. This follows from the cumulative hazards met in building larger pieces of chemical stoneware, which are naturally reflected in their higher price. For example, a storage tank of 800 gal. can be made in one piece, but this size is uneconomical to build, and an equivalent number of smaller units usually is more desirable. An alternative frequently used is the lined tank, made of steel, concrete, or wood and lined with chemical stoneware brick, set up with acidproof mortar. Tanks of this sort are unlimited as to size and shape.

Where a large apparatus is clearly indicated, certain design characteristics must be provided. For instance, it is necessary to have a relatively thick wall if warpage is to be held to a minimum. On open sinks or tanks, a rim around all openings must be provided to aid in maintaining shape. Corners must be well filleted to avoid cracks.

Chemical stoneware has a number of limitations which must be understood. One concerns the thickness of body, which, of course, varies with the size and shape of the equipment, but must not exceed the limits of $\frac{3}{16}$ in. to 4 in. in any case. A second limitation is in temperature change. Chemical stoneware should not be used where abrupt temperature changes are liable to occur unless it is possible to heat the entire ware very evenly. Regular stoneware bodies are not generally suitable for use above 100 deg. C. Special bodies of more costly nature may be produced to take care of temperature conditions in excess of this value, or where high heat shock is anticipated. Gradual and even heating always is to be preferred if maximum life is expected.

Selection of the glaze finish for a piece of chemical ware, as was intimated above, is of more or less minor importance, so far as the utility of the finished product is concerned. Very little chemical ware is produced without glaze, and this only where some special condition demands it. Of the two glaze methods of finishing, then, liquid glazes and modifications of the old type of salt glaze are commonly used for all types of stoneware. Liquid glaze is composed of clays capable of high colloidal dispersion, compounded with materials which when applied to the surface of the ware prior to burning will produce, at the high temperature of the kiln, a tight, lustrous finish of acid-resistant character. Salt glazing

is accomplished by the use of sodium chloride, which is thrown on the kiln fires shortly before the end of the burn. The NaCl is dissociated at the high kiln temperature, the chlorine combining with hydrogen to form HCl vapor, which passes off with the flue gases. The sodium radical combines with the surface material of the ware to form a double silicate of sodium and aluminum which is of neutral character. Although this coating is normally transparent, it is colored by various impurities in the clay and in the flue gases. Its color may be further controlled by the addition of certain chemicals to the green clay during milling. Under severe abrasion and the continual application of certain chemicals, either type of glaze may in time be removed from the ware. This does not, however, affect the corrosion resistance of the body itself.

Liquid glazing is more expensive than the salt method and possesses the advantage of being capable of application only where it is desired. Its color usually is more uniform and hence may present a better appearance. Salt glazing, however, is more commonly used and the additional expense of the liquid glaze is frequently not justified.

By way of summary, I wish to emphasize a number of the points which have been made above. Chemical ware is a highly specialized clay product suitable for a large place in the corrosive-fluid field. As such, it should be designed by those who are conversant with its basic characteristics. It should be made for the operation in which it is to be used, and this requires close design co-operation between the consumer and producer. Finally, if it is at all possible to use shapes and sizes that are standard with the manufacturer, this will yield savings that are well worth the taking.

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Ceramic Society and Industry Groups Meet in Cleveland

CLEVELAND has the reputation of being a good host and it was evident that the more than 1,500 registrants at the American Ceramic Congress, held there during the week of Feb. 22, found the reputation not unwarranted. The thirty-third annual meeting of the American Ceramic Society was made the occasion for simultaneous meetings of the Vitrified China Manufacturers' Association, National Brick Manufacturers' Association, Canadian National Clay Products Association, American Refractories Institute, Grinding Wheel Manufacturers' Association and the Feldspar Grinders' Institute. The Congress also sponsored a Ceramic Exposition which enabled the public to view the displays of more than 60 exhibitors. These included showings of both equipment and ceramic products, with the former considerably in the preponderance.

Formation of a Materials and Equipment Division of the Ceramic Society was an important development, as was the consolidation of the N.B.M.A. with the Heavy Clay Products Division. Another outstanding action taken at this time by the Society was the installation of a higher grade of membership with which to award those ceramists deserving of special note. The grade of "fellow" was established in 1930 but it remained for the present meeting to award the new fellowships to 153 members to whom the honor has initially been given. Following the fellowship awards, new officers of the Society for the coming year were installed, as follows: E. V. Eskesen, Federal Seaboard Terra Cotta Company, New York, president; Dr. Alexander Silverman, University of Pittsburgh, vice-president; Dr. H. B. Henderson, Standard Pyrometric Cone Company, Columbus, treasurer; R. C. Purdy, Columbus, secretary; and as trustee, E. P. Poste, Chattanooga Stamping & Enameling Company, Chattanooga, Tenn.

Indicative of the widespread interest which the meetings held for ceramists and ceramic ware manufacturers is the fact that more than 150 papers were presented before the seven divisions of the Society. In a number of papers given before the Glass Division, F. W. Preston drew some instructive conclusions regarding the mechanical properties of glass. A mathematical analysis has shown that the strains in wire glass are of considerable magnitude. Stress in the wire is of the magnitude of 25,000 lb. per square inch, and in the glass, about 250 lb. In another paper he showed that there is no substantial difference in mechanical strength of the ordinary glasses of different American manufacturers.

A survey of a great deal of data on the strength of building stones and heavy clay products has led Prof. J. H. Griffith to the belief, expressed in a paper before the Heavy Clay Products Division, that a formulation of the strength of the material may be based on its absorption of water, from which the percentage of sensible pore space may be derived. His formulation is:

$$p = \frac{80{,}000}{A + 4} (1 \pm 0.25)$$

where p is the stress at rupture and A is the percentage sensible pore space determined by the degree of absorption of water by weight.

Papers read at the meetings of the Refractories Division included a description of the technique involved in Dr. T. S. Curtis' much-discussed method of observing ceramic changes and reactions by means of the slow-speed motion-picture camera. For observations at high temperature Dr. Curtis heats his sample within a minute furnace on a small platinum strip heated by an electric current. For illumination he uses an arc light which is rich in blue rays, while he filters out the red and yellow radiation from the heated body by means of a blue optical filter, thus permitting photography through one optical system of a binocular microscope. Photographic equipment for such research is now commercially available. Also before the Refractories Division, R. M. Langley discussed the application of insulation to glass furnace regenerators. Savings in fuel, reduction in air leakage and better control are possible without deteriorating effects on the refractories due to the insulation.

Electrical dewatering of clay suspensions was described before the White Wares Division by C. E. Curtis who dealt first with earlier investigations and the German plants using this method and then gave the results of his own investigation which showed that a cost of 65-80 cents per ton of clay dewatered could be expected. The process may offer advantages over filter-pressing for very fine suspensions. Dr. T. S. Curtis appeared before this division and described "Vitrolon," a new ceramic body used as a flux in the production of a low-temperature white ware which is said to cut turn-over time from about 30 to 5 days.

Oyster Shells as Raw Material For Chemical Lime

By J. B. NEALEY
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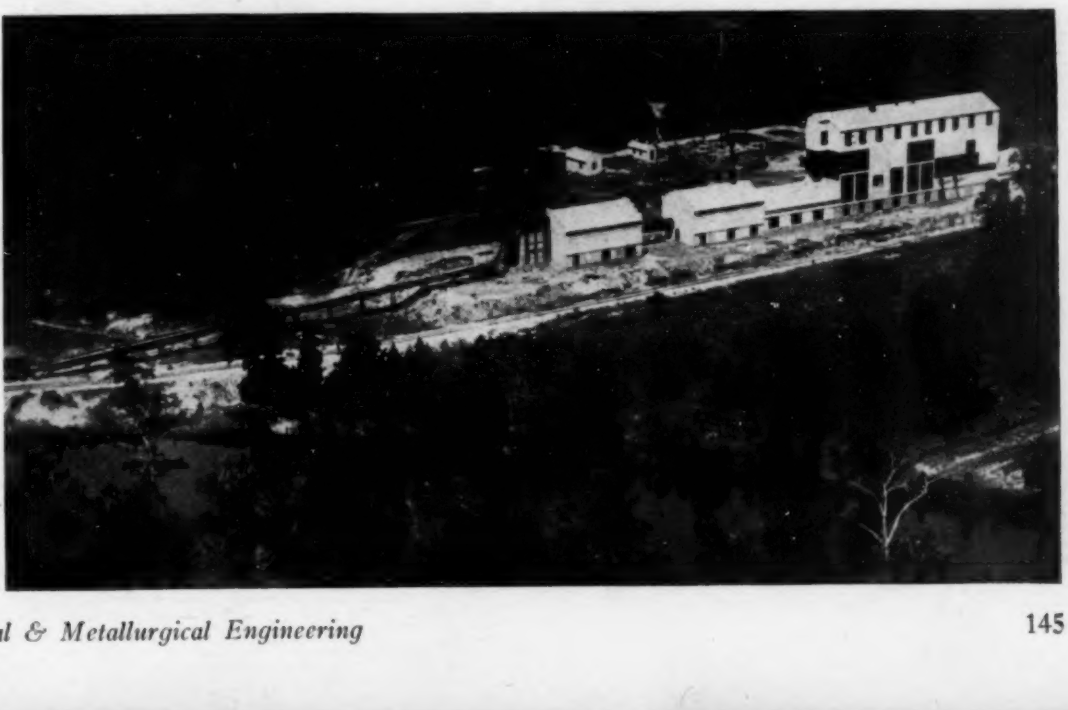
WITH the increase in competition, the lime-consuming industries, and particularly the chemical users, are demanding chemical lime of greater purity and uniformity of composition. Although mechanically contained adulterants usually can be removed or avoided, most limestones include considerable quantities of chemically combined impurities which are difficult, and often impossible to remove economically. The percentage of these impurities increases with the conversion to lime. For instance, a limestone containing 2 per cent of non-volatile impurities will, if perfectly burned, produce a quicklime with approximately 3½ per cent of impurities; and a perfectly hydrated lime made from this will contain more than 2½ per cent of impurities, in the absence of methods of purification.

Oyster shells have long been recognized as one of the purest forms of calcium carbonate occurring in easily available commercial quantities. When reef oysters are dredged, they carry considerable quantities of mechanically trapped silt, sand, and other foreign material, but the shells themselves constitute an extremely pure raw material for lime making, because they contain a minimum of chemically combined adulterants.

Easily accessible shell reefs of sufficient size and proper character to warrant their use as the base of a lime-producing industry are few and far between, and this is one reason why so little progress has been made in this direction heretofore. It was left to the Haden Lime Company, Houston, Texas, to solve the problems incident to producing lime from oyster shells and to erect the only plant of its kind and one of the very few using this raw material. Through its subsidiary, the W. D. Haden Company, it controls extensive oyster-shell reefs on the Gulf Coast of Texas, and dredging and preliminary washing are accomplished with its own equipment, which was specially designed for this work. The dredges are equipped with Diesel engines and large centrifugal suction pumps. A pipe leg runs down to the reef, where a revolving toothed wheel cuts and loosens the shell formation, which is then sucked up through the pipe and poured into the barges. Each barge holds 300 tons of shells and can be loaded in 1¼ hours.

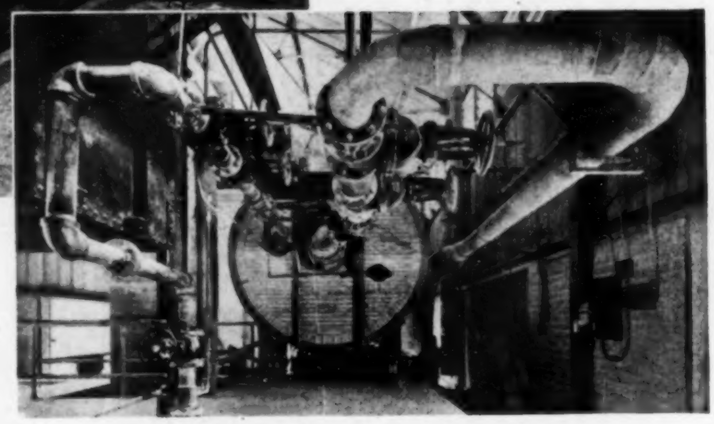
There are two grades of shells, the poorer of which, known as mud shell, is used on roads, as ballast on railroad beds, and for cement making. Instead of dumping this into the barges direct, it is first put through a washer on the dredge. It is then sold without further processing.

Shells to be made into lime are delivered at the lime plant on Greens Bayou, which is tributary to the Houston Ship Channel. There they are unloaded into stockpiles with a caterpillar crane and clamshell bucket. From the stockpiles shells pass into a hopper and thence to a belt conveyor which delivers them to an agitated screen of 1¼-in. mesh. Oversize shells from the screen are discharged directly into a roll crusher, and reduced to the same size as the undersize which passed through the screen. A belt conveyor runs under both machines, thereby combining the screened undersize with the

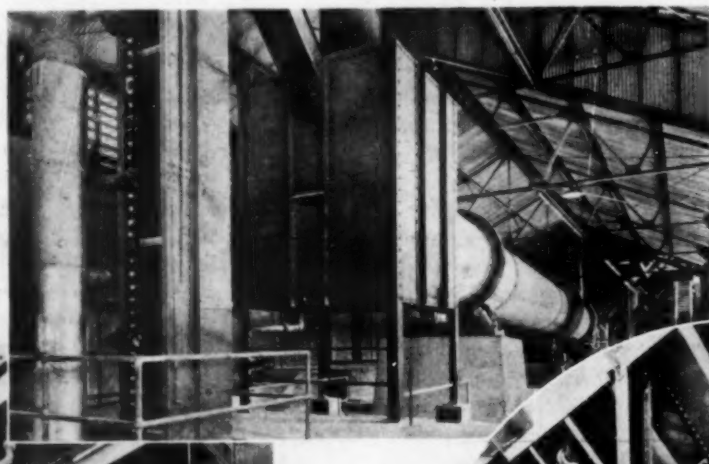


Plant of The Haden Lime Company Near Houston, Texas, Is One of the Few in the World Operating on Oyster Shells for the Production of Hydrated Chemical Lime

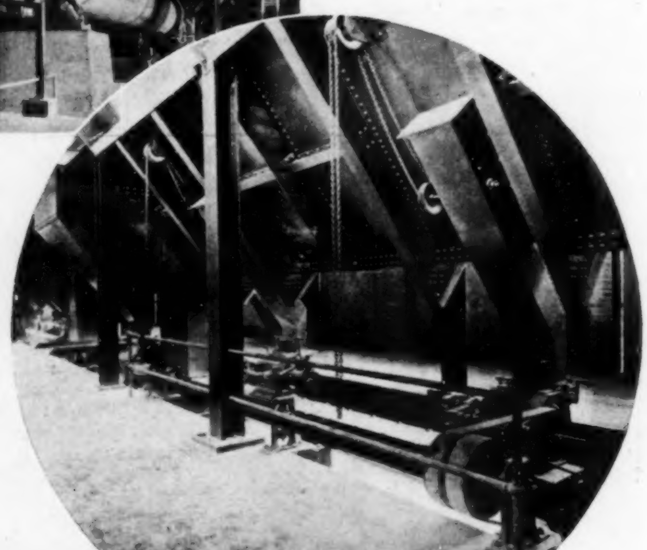
After crushing and rough sizing the shells are delivered to this jig washer for cleaning and grading preparatory to calcination



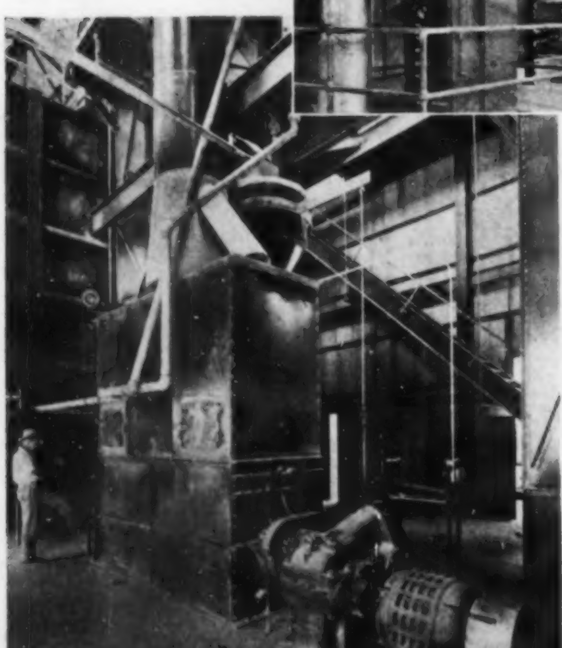
At the right is the firing end of the rotary gas-fired kiln, showing gas and air piping, with temperature control equipment at the right. The kiln is 125 ft. long x 7 ft. in diameter and is surrounded by a shell or hood for preheating the combustion air



A rotary cooler 60 ft. long x 6 ft. in diameter receives the hot quicklime from the kiln via an elevator and discharges the cooled product to the raw lime storage bin

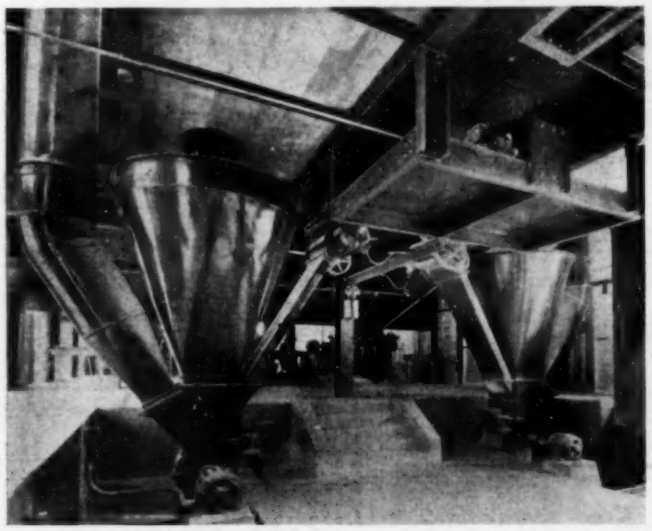


From the raw lime storage bins below, the lime passes through feeders to a screw conveyor and by way of a bucket elevator to the hydrator feed hopper



Water and lime are automatically proportioned for every batch put through the hydrator at the left, assuring a uniform product

crushed shells. This conveyor delivers the shells to a modified jig-type washer with reciprocating pistons. This has four compartments stepped at slightly lower levels. The washed shells are discharged into a bucket elevator and delivered to the storage hopper which feeds



Pulverizers Equipped With Air Separators Are Used to Grind and Regulate Size of the Finished Hydrate

into the kiln. Excess water drains out through perforations in the buckets, so that the material is only moist when it reaches the kiln.

The kiln, of the rotary, gas-fired type, is 125 ft. long and 7 ft. in diameter. It is driven by a 30-hp. motor. The discharge end is closed by a circular hood of brick and steel, fitting over the outside of the kiln, and set on wheels so that it can be rolled away when desired. The gas burner is located in the center of the end wall of this hood. Gas is used at the rate of about 600 cu. ft. per minute, and hot air, taken from a hood built around the outside of the kiln, is supplied to the burner by a motor-driven blower, the gas and air being mixed in the proper ratio for complete combustion. The calcining zone of the kiln is maintained at between 2,200 and 2,400 deg. F. This temperature gradually drops as the products of combustion travel through the preheating zone, until they are discharged into the stack at about 1,000 deg. F. The calcining zone of the kiln is about 70 ft. long and, with the kiln rotating at 1 r.p.m., it requires approximately 2¼ hours for the material to pass from the charging to the discharge end.

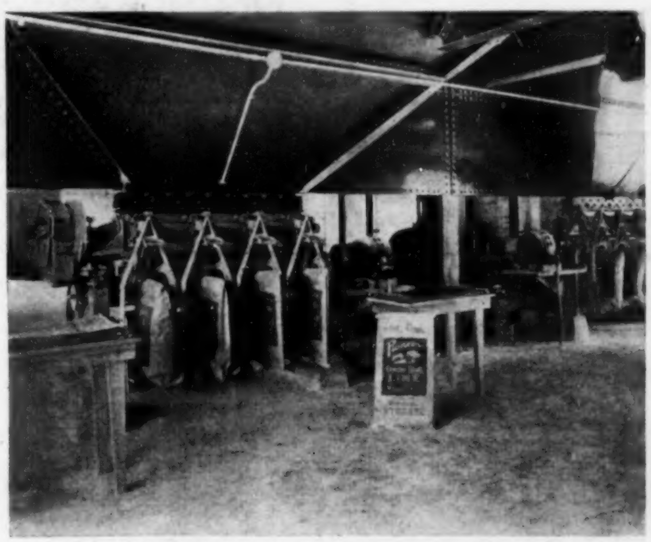
At the charging end is located a dust chamber 20 ft. square and 30 ft. high, through which the products of combustion pass on their way to the 94-ft. stack, depositing from 75 to 80 per cent of the included dust. At the discharge end, the burned lime drops down into a pit and is lifted and charged into the cooler by bucket elevator. The cooler is 60 ft. long and 6 ft. in diameter and is driven by a 20-hp. motor.

Cooled material is delivered by a bucket elevator to the raw lime storage, which consists of an airtight steel hopper of 22,000 cu. ft. capacity, divided into four sections. Each section is equipped with a motor-operated feeder of the propeller type, actuated through a link and cam device. From the feeders lime travels by way of a screw conveyor and a bucket elevator to an overhead hopper equipped with weighing scales which, in turn, discharges into the hydrator. The hydrator is of steel, airtight in construction and is 12 ft. long, 4 ft. wide, and 15 ft. in height.

Batches for the hydrator are made up in the hopper, the operator setting the hopper scales and pushing a button which starts up the conveyor motors. When the correct quantity of raw lime has been delivered, the scales trip a Mercoid switch, stopping the motors. The operator then dumps the lime into the hydrator and opens the water tank valve and lets the water into the hydrator. When he closes this valve, another valve in the feed-water line is opened automatically and when the correct weight of water has run into the tank, this valve closes automatically.

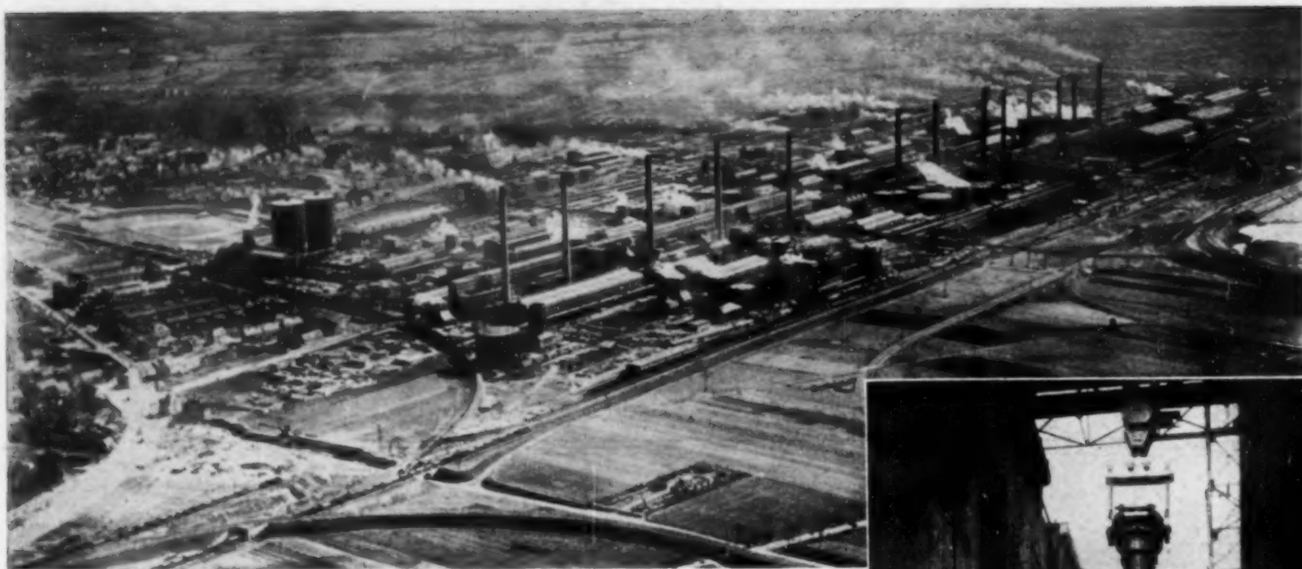
The batch is agitated during hydration by revolving steel paddles. Theoretically the formation of $Ca(OH)_2$ requires a batch containing about 25 per cent by weight of water. Actually the reaction is so rapid and generates so much heat that the temperature is raised above 212 deg. F., steam is evolved, and considerably more water must be used. The reaction time is about ten minutes, and the product, now a fine, white powder known as "raw hydrate," is carried by another screw and a bucket elevator system to a series of storage bins similar to the raw lime bins previously described.

It is withdrawn from these, as desired, and delivered to air-separation pulverizing mills which reject any coarse or heavy particles and deliver the fine floated hydrate to cyclone dust collectors, the finished hydrated lime dropping from these into storage bins, from which it is delivered to the automatic bagging machines. There are two mills used, one for chemical and one for masons' hydrate. The product of the chemical mill is so fine that over 98 per cent will pass a 325-mesh screen. The second mill, for masons' hydrate, delivers a product which is not quite so fine. For making a special product the first mill can be set so that 99.9 per cent of the hydrate will pass a 325-mesh screen.



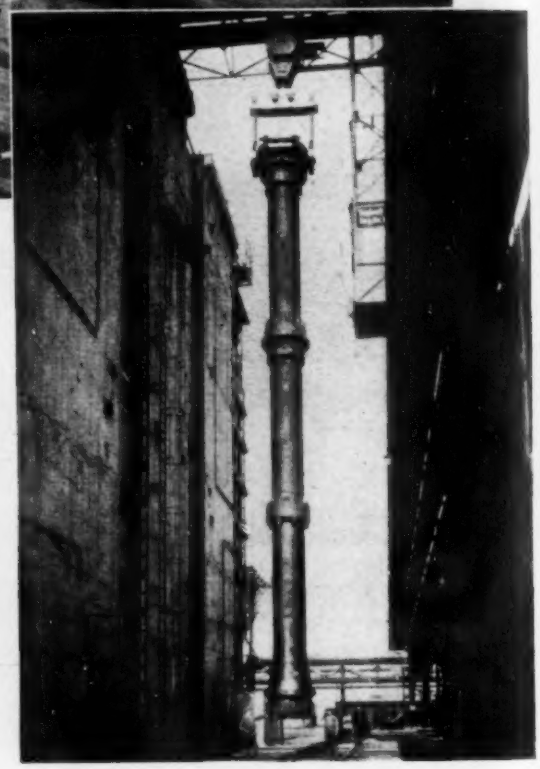
These Automatic Bagging Machines Require Four Men for the Packing of 600 Bags per Hour

Finished hydrate is packed in bags that are sewed at both ends, leaving a small, self-closing opening in one corner. These are hung on the scale racks of the bagging machines, with the feed pipes entering these openings. When the proper weight of material has been dropped into a bag, the scale trips and stops the feed. Four men are able to fill 600 bags per hour. All dust is removed from the vicinity with a suction fan.



General view of the Leunawerke, world's largest chemical plant, which centers around synthetic ammonia production

Hydrogenation research laboratory with small-scale equipment

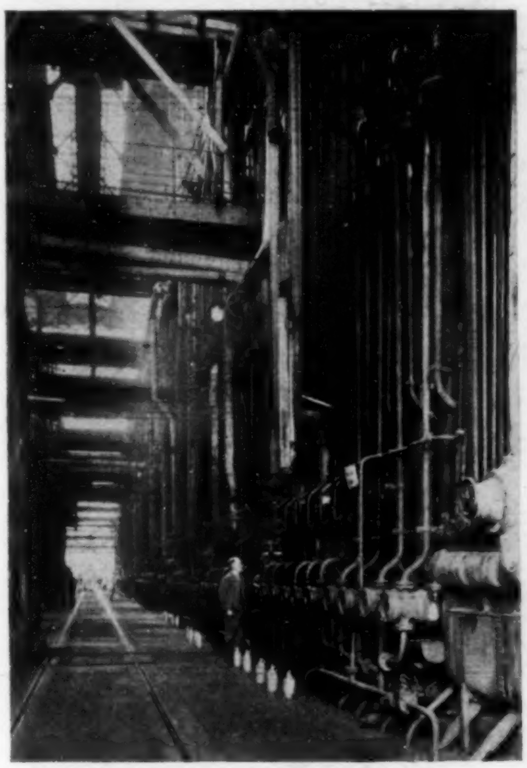


***Hydrogenation autoclave at Leuna,** 18 m. long, about to be placed in concrete stall at **left.** Vertical preheaters appear at right and left rear*

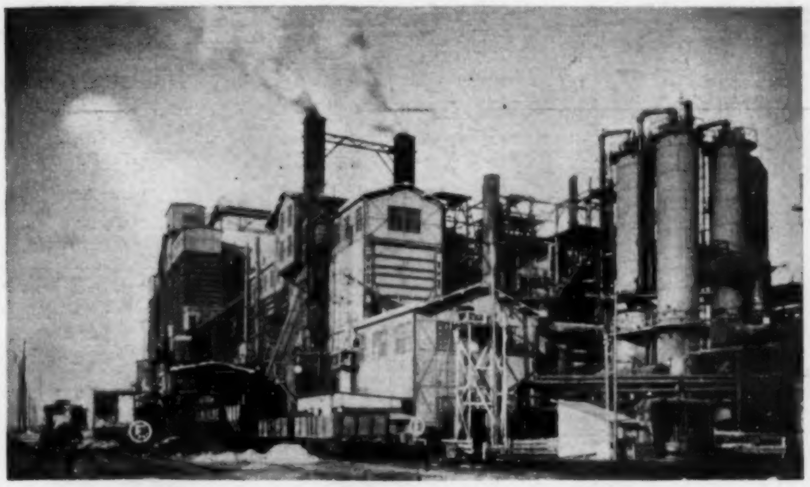
Methanol synthesis plant: on the left are methanol coolers and separators; on the right, CO removal by means of cuprammonium solution

An Intimate Glimpse of German Industry

In the latter part of 1930, Carleton Ellis, of the Ellis-Foster Company, Montclair, N. J., spent several months visiting the principal chemical industries of Germany and Great Britain. His responsive reception there enabled him to gain a singularly intimate impression of what these two other chemical leaders are achieving on an industrial scale. At the meeting of the American Institute of Chemical Engineers in New Orleans, last December, Mr. Ellis first narrated his experiences abroad in an illustrated talk; but because they are of such wide interest, and not yet generally accessible, some of his photographs have been selected for presentation on these pages. They all show phases of the I. G. Farbenindustrie's activities; that is, the present state of Continental technology



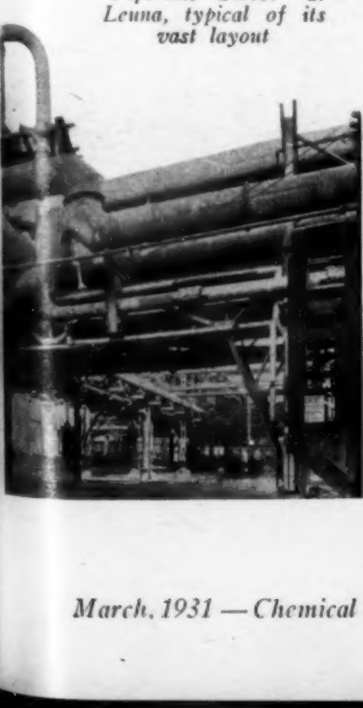
Distillation and fractionation apparatus for hydrogenated oil products at Leuna



Plant at Leuna for low-temperature distillation of bituminous coal. Gas-scrubbing towers to the right

Urea storehouse of the I.G. at Oppau, holding 25,000 tons, the world's largest source. The scale of operations is shown by the workmen posed in front of the material. A product of synthetic ammonia and long used as a fertilizer, urea has been adopted as the raw material for synthetic resin manufacture by Mr. Ellis, who has just completed work on a suitable cheap plastic product called Unyte. Samples have been displayed recently and, because of their coloration and translucency, large-scale manufacture is expected to expand this new market for urea

"Pipe-line Street" at Leuna, typical of its vast layout



Southern Chemical Industry Developing in Importance

By L. B. HITCHCOCK

Associate Professor of Chemical Engineering
University of Virginia,
University, Va.

CHEMICAL industry plays a rôle in Southern manufactures twice as important as in the United States at large. This peculiarity is explained by the fact that chemistry in the South depends largely on local resources of great extent, such as petroleum, cotton, and pulp wood. Including 30 per cent of the land area and population of the continental United States, the Southern states contribute but 14 per cent of the value of all American fabricated products; yet 20 national chemical industries owe 26 per cent of their production to Southern plants. Continued industrial development in the South may be expected not only to maintain this ratio of chemical to other activity but in all probability will increase it, because of the large mineral resources of known extent and the potential chemical resources of vegetable origin and of unlimited extent.

Capital outlay for permanent buildings and equipment is not taking place in the South, because of a belief that cheap labor is an inherent characteristic of the region. As long as it lasts it is a pleasant consideration to the enterpriser. But his chief interest in the South must be ascribed to more permanent factors. These include mineral deposits of great variety and crops favored by Southern conditions; in short, raw materials of large extent whose chief mode of utilization involves applications of chemistry.

Virginia, site of the first chemical industry in America, with exports of glass, potash, and naval stores from Jamestown in 1608, is experiencing development today which promises to convert the James River basin into America's foremost chemical center. Scores of centers of progressive chemical industries throughout the South might be cited, all engaged in new and socially beneficial manufactures of exceptional interest.

Based upon an article, "Chemical Resources and Industries of the South," in the January, 1931, issue of The Annals of the American Academy of Political and Social Sciences.

The importance of chemical industry in the South can be judged only by comparison with general industrial development in the same area. Table I presents comprehensive totals for important index items, indicating that while the South possesses 30 per cent of the land area and population, it contributes but 14 per cent of the value of the country's manufactured goods with the help of 18 per cent of the wage earners.

Table I—General Industrial Statistics for the Southern States—1927*

	United States	Southern States	Per Cent of U. S.
Land area, square mile†	2,973,774	880,106	29.6
Population (1930)‡	122,698,190	37,095,853	30.2
Number of establishments	191,866	31,925	16.6
Wage earners (average)	8,353,977	1,474,901	17.7
Wages, $1,000	10,848,803	1,365,809	12.6
Horsepower	39,045,940	7,044,604	18.0
Cost of materials, etc	35,133,137	5,052,014	14.4
Value of products in thousands of dollars	62,718,347	8,619,893	13.7

*Compiled from 1927 Census of Manufactures, U. S. Dept. of Commerce, 1930.
†World Atlas, p. 30, Rand, McNally & Company, 1927.
‡Taken from the *United States Daily*.

Table II—Twenty Representative Chemical Industries*

	United States	Southern States	Per Cent of U. S.
Number of establishments	10,974	3,700	33.7
Wage earners (average)	611,735	179,363	29.3
Wages in thousands of dollars	771,216	171,055	22.2
Horsepower	6,300,867	1,316,781	20.9
Cost of materials, etc	4,383,307	1,257,067	28.7
Value of products in thousands of dollars	6,998,776	1,789,018	25.6

*Compiled from Census of Manufactures for 1927.

Comparing the same subjects in the same way, but solely on the basis of the 20 selected chemical industries, the illuminating results shown in Table II are obtained. With nearly 26 per cent of the nation's chemical manufactures contributed by the South, from 34 per cent of the number of chemical establishments, employing 29 per cent of the chemical wage earners, we find that this phase of industry has kept much more closely in step with the growth in population.

Table III—Distribution of Chemical Industries in the Southern States[1]

Chemical Industry	Value of Products In United States $1,000	Percentage of "Value of Products in U. S." in each Southern State (2): South	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Md.	Miss.	N. C.	Okla.	S. C.	Tenn.	Tex.	Va.	W. Va.	Southern States Not Indiv. Disc. (3)
1 Black, carbon, etc	$14,262	75.6	.....	.....	.....	.....	(3)	50.3	.....	.....	.....	....	....	....	23.2	....	1.60	0.53
2 Chemicals, n. e. c	548,536	10.1	(4)	(2)	.....	.....	(1)	(1)	2.20	.....	(1)	....	(1)	1.79	(2)	1.49	1.96	2.63
3 Clay products	319,908	16.1	1.67	0.40	0.15	1.52	2.30	0.14	1.48	0.36	1.19	0.53	0.59	1.17	1.95	0.92	1.71	0
4 Coke, blast	382,013	14.5	6.68	.....	.....	(1)	(2)	.....	(1)	.....	.....	....	....	0.39	....	0.37	3.00	4.03
5 Cottonseed products	276,338	96.6	5.30	6.24	(1)	10.13	(2)	7.71	.....	10.11	6.37	7.35	4.56	5.52	28.3	3.38	.....	1.60
6 Explosives	72,490	10.93	(3)	(1)	.....	.....	0.38	.....	.....	.....	.....	0.43	....	(2)	(4)	....	0.60	9.52
7 Fertilizers	190,385	70.1	4.99	0.48	7.78	11.6	(2)	2.18	14.25	1.46	9.68	....	6.16	2.58	0.43	8.02	(1)	0.53
8 Gases, liq. and comp	50,547	18.1	1.41	(1)	0.24	2.10	0.62	1.93	(4)	.....	(3)	(5)	(1)	0.82	3.72	2.64	(3)	4.65
9 Gas, manufactured	516,705	8.5	0.26	(1)	1.02	0.99	0.10	.....	2.14	0.15	0.60	....	0.31	0.65	0.34	0.99	.....	0.98
10 Lime	41,587	24.5	3.63	0.91	(2)	(1)	(1)	.....	1.24	.....	(2)	(1)	(1)	3.14	2.79	4.58	6.01	2.16
11 Naval stores	39,903	100.0	7.27	.....	33.8	45.3	....	3.66	.....	6.4	0.12	....	2.36	....	1.11	....	.....	0
12 Oils, n. e. c	103,388	6.7	(1)	.....	.....	(4)	....	(1)	3.14	.....	.....	(1)	....	(1)	(1)	....	.....	3.58
13 Paint and varnish	519,010	5.7	0.19	.....	0.03	0.19	1.92	0.33	0.83	.....	(2)	(3)	(1)	0.40	0.44	0.13	0.69	0.52
14 Paper	919,891	6.8	(1)	.....	.....	(2)	....	1.69	1.23	(1)	(4)	....	(2)	0.25	(2)	2.12	0.50	1.02
15 Patent medicines, etc	278,243	12.4	(7)	0.06	0.40	1.43	0.24	0.49	4.47	(1)	0.72	(2)	0.01	2.37	0.56	0.67	(2)	0.95
16 Perfumes and cosmetics	161,246	6.6	(3)	.....	(3)	0.33	(4)	0.13	0.37	(1)	(1)	0.11	....	3.24	0.18	0.18	.....	2.04
17 Petroleum refining	2,142,649	37.9	.....	0.59	.....	(1)	0.38	6.45	(3)	.....	.....	7.16	(1)	(1)	20.0	(1)	0.69	2.58
18 Pulp	218,198	15.7	.....	.....	.....	.....	....	3.36	(2)	(1)	(2)	....	(1)	1.4	(1)	5.15	(4)	5.78
19 Rayon[4]	167,800	61.9	.....	.....	.....	0.61	....	.....	5.68	.....	0.51	....	....	13.12	....	29.40	12.59	0[4]
20 Tanning materials	35,677	26.5	(2)	.....	(2)	1.23	....	.....	(1)	.....	3.58	....	(2)	4.27	....	9.29	.....	8.10
Total	6,998,776	25.6	0.89	0.47	0.51	1.23	0.39	2.86	1.39	0.50	0.67	2.56	0.41	1.19	7.54	1.88	1.07	2.05

(1) Compiled from 1927 Census of Manufactures, U. S. Dept. of Commerce, 1930.
(2) Numbers placed in parentheses in this table, indicate the number of establishments for the given industry and state, in cases where other statistics are not furnished in the Census of Manufactures in order to prevent disclosing data reported by individual establishments. Their combined production is included in the data shown in the column headed "Southern States—Not Indiv. Disclosed."
(3) Production of Southern States not disclosed for individual states is estimated by means of the ratio of "Number of Establishments" in the affected states to that number for all "Other States."
(4) Rayon figures are an estimate based upon *Textile World*, 77, 645 (1930), for the calendar year 1929, in conjunction with the 1927 Census.

Corrosion Problems Feature T.A.P.P.I. Meeting

EDITORIAL STAFF REPORT

CONTRARY to the recent experience of most societies, the annual meeting of the Technical Association of the Pulp and Paper Industry, held in New York City, Feb. 17-19, was the best attended in the history of the organization. That fact proves the very active interest of the technical men of the pulp and paper mills in management, engineering, raw materials, operating, testing, research, and development. The meeting closed with the general luncheon, at which J. C. Esselen, consulting chemical engineer, of Boston, and H. P. Carruth, vice-president of the Mead Pulp & Paper Company, one of the founders of the society, were among the speakers.

One of the most interesting symposiums of the entire convention was that on materials of construction. Chairman J. D. Miller, of the York Haven Paper Company, opened the meeting by introducing W. A. Wissler, of the Union Carbide & Carbon Research Laboratories, who presented a paper on the applications of hard facing materials in the pulp and paper industry. Wissler stated that hard facing is a logical way to attack and solve the problem of abrasion. Whenever wear occurs, the hard facing process applies by welding methods a coating or edge of an alloy that has been designed specifically to resist abrasive wear. This process, therefore, makes it possible to use the most satisfactory metal, both in regard to properties and cost for the bulk of the part, and to apply the specialized alloy in the places at which it is needed. Better grades of hard-facing alloys are brittle and weak as compared to steel; hence it would be inadvisable from the point of view of performance as well as cost to make the entire part of these metals.

The galvanic behavior of a chromium-nickel-iron alloy in sulphite liquors was discussed by W. Andrew Wesley and F. L. LaQue, of the International Nickel Company. Galvanic corrosion was defined as the abnormal corrosion resulting from the electrical connection of two or more dissimilar metals in contact with a corrosive liquid. The authors concluded that chromium-nickel-iron can function as cathode in galvanic couples in neutral and in acid solutions, without destruction of the surface film, which renders it passive in these electrolytes. Mechanical and other disturbance of the surface of this alloy render it active, at least temporarily, in which condition it behaves more nearly like iron than like the noble metal.

Advantages of copper pipe in the paper mill were discussed by Charles A. Hill, the Mueller Brass Company, and Leland T. Summers, chief chemist, Port Huron Sulphite & Paper Company. The authors discussed the advantages offered by copper in preventing corrosion, and stated that a satisfactory method has been developed in which the pipe is connected by soldering. The soldering is done by the application of solder wire fed into conveniently placed openings in the fitting by the aid of a blow torch and the natural law of capillary attraction. When the job cools, a permanently tight joint is effected.

The non-scaling quality of copper pipe admirably suits it for use in blow pits and screen rooms, where the air is extremely moist and slightly acid, due to these departments being in close proximity to the digester room and the acid plant. Copper pipe is equally suitable for use in stock lines conveying bleached as well as unbleached pulp.

The progress that has been made during the past two years in improving the corrosion resistance of alloys was the subject of a paper by John A. Mathews. Dr. Mathews concluded his remarks by stating that there is much to encourage us as the result of both the experimental and commercial uses of the alloy in the paper industry. Some of the failures that have been noted can be explained. When their metallurgy and properties are understood better more will be known about how to use these fields. They are so different in character from the customary engineering material with which industry has been familiar for many years that there is presented many new problems in connection with their use. No object in the steel industry has been the subject of so much research as have the corrosion-resistance fields during the past five or six years. The actual use of these materials in industry has only commenced and another two years will show practical accomplishments based upon the results attained by research and cooperative efforts between industries such as paper and steel.

Applications of carbon, plastics, and modifications of the "18-8" chromium-nickel-ferrous alloy were discussed by James A. Lee, assistant editor, *Chem. & Met.* This paper appears elsewhere in this issue.

An unusually large attendance was attracted to the general session. Frederick W. Adams, assistant professor of chemical engineering, Massachusetts Institute of Technology, presented a paper on steam consumption in the drying of paper, in which he developed the following formula:

$$\frac{\begin{pmatrix}\text{Theoretical}\\ \text{steam}\\ \text{consumption}\end{pmatrix}\left(1+\dfrac{0.4\ (\text{per cent time down})}{100-(\text{per cent time down})}\right)}{\left(1-\dfrac{\text{Per cent Broke}}{100}\right)\left(1.005-\dfrac{\text{Per cent Trim}}{100}\right)\left(1-\dfrac{\text{Per cent Steam Bypassed}}{100}\right)}=\begin{matrix}\text{actual}\\ \text{steam}\\ \text{con-}\\ \text{sumption}\end{matrix}$$

The paper machine operating factors affecting drying were indicated.

Heat conservation in paper mills was discussed by D. K. Dean, development engineer, Foster Wheeler Corporation. Dean stated that the steam set free when a digester is blown and when paper or pulp is dried on a machine contains heat units that should be utilized. His company has developed a heat exchanger that has been in use for more than a year and produces a saving of

$15,000 annually per digester. A cooling tower is used to condense the machine room vapors.

Subjects of other papers were: the transfer of heat through cast-iron dryer shells, by A. C. Stamm, the Upsom Company; felt operation, by R. W. Pattison, American Writing Paper Company; low-pressure steam and paper-machine drying, by Donald Ross-Ross, Howard Smith Paper Mills, Cornwall, Ontario; the efficient drying of paper, by E. W. G. Cooper, Crown Williamette Paper Company, Camas, Wash.; and suction rolls, by B. T. McBain.

A feature of the session on waste and finishing was the paper on water purification for color removal, by A. F. Behrman, R. H. Kean, and H. Gustafson, of the International Filter Company. The paper covered the chlorination and filtration through activated carbon. They drew the conclusion that developments in water purification have made it possible to approach practically any color-removal problems with confidence; that no one method of color removal can be recommended blindly as the best for all cases; and that the fundamental principles of each method must be thoroughly understood to obtain the most satisfactory results from that procedure.

Resistance of pipe to paper-stock flow was considered by F. Forest, Allis-Chalmers Company, in his contribution to the heat and power committee of the engineering symposium. Forest's paper brought forth much discussion.

J. W. Boyd's paper described the mechanical handling of pulpwood with the power rake. This pulpwood rake was developed at the suggestion of Joseph Warren, mill manager of the S. D. Warren Company. The rake has been tried and is now a proved device, having been in successful operation for over two years, performing both functions of storing and reclaiming.

Among the other papers at this same symposium were the use of synchronous motors in the paper industry, by D. R. Shoults; steam turbines in paper mills, by R. G. Standerwick; and utilization of the fuel value of sulphite waste liquor, by H. S. Kimball.

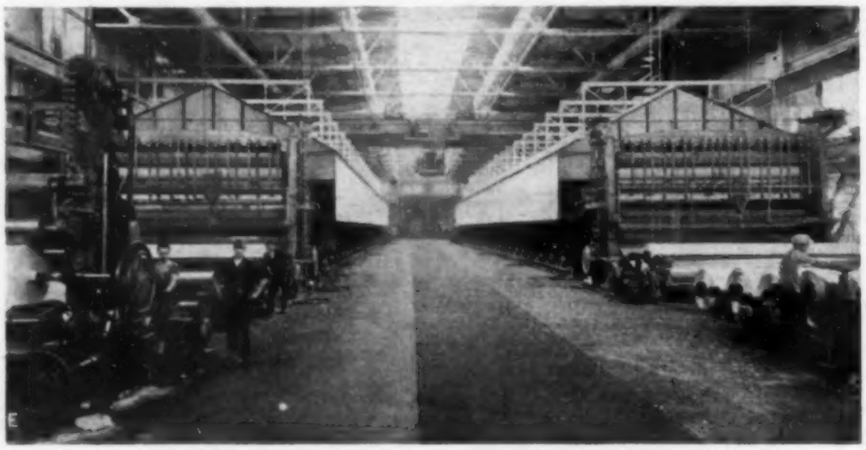
A feature of the stuff-preparation and pulp-testing sectional meeting was the paper presented by F. W. Motschman, of the International Paper Company, on practice and control of beating and jordaning. Instruments in generous use will soon pay for themselves as part of the control system. Motion recorders will show beater roll and jordan plug manipulations. Liquid-level gages recording the quantities of stock in the beater and machine chest will show also how fast the stock is being run over into the machine chest; will show on whose tour that bunch of stock was run over onto the basement floor; and will kill the story about having to shut down for stock. A temperature clock on the tray water will show the excessive use of fresh water in the system and also any excessive steam usage at the machine white-water tank or wire tips. A recording vacuum-couch gage will prove the uniformity of operation and may be used by the machine tender to indicate change in porosity on a fussy order, or to show the change in caliper on a tag sheet, provided the stock has remained the same.

H. E. Pratt, in his paper on classes of color used in the dyeing of paper, gave a brief review of basic, acid, direct, and pigment applications to paper coloring in which their limitations were pointed out. Freeness testing was discussed in papers by F. C. Clark and F. L. Simons, of Skinner & Sherman, Inc. F. W. Motschman's paper on practice and control of heating and jordaning was read by title only.

As a contribution to the alkaline pulp sectional meeting, H. W. Morgan presented a paper on wood evaluation for soda pulp manufacture. The importance of careful control of the quality of soda pulp wood and the present methods of grading were briefly discussed. The effects of the decay on the composition of wood also were discussed and the relation of these effects to the pulp yield were pointed out.

J. R. Lester and G. H. Finks, of the Alabama Power Company, in their paper on the purchase of electric energy and steam by the Southern paper industry, made the interesting statement that steam and electricity purchased by the paper industry when obtained from a competent and responsible utility, at fair prices, is good business practice, since it avoids burdening the paper-mill organization with power-plant operation. Net incomes in Southern kraft mills where steam and electricity may be purchased should show an increase of approximately 3 per cent on the total investment as compared with mills producing all electricity and steam. The fact that the utility, through its diversified sale of power, can afford to construct and maintain power plants on a lower basis of fixed charges than is considered prudent for industrial plants, is responsible for the increase in net income.

Among the other contributions that attracted much attention were: the rapid circulation in sulphite cooking, by R. W. Hovey and A. D. Merrill; the pulping of Southern black gum by the sulphite process, by G. H. Chidester, Forest Products Laboratory; and one hundred per cent groundwood for newsprint, by O. L. E. Weber and W. J. Garding, Watah Paper Company.



New Materials of Construction Reduce Corrosion Losses

By JAMES A. LEE
Assistant Editor, Chem. & Met.

INDUSTRY'S annual corrosion bill is enormous. An estimate of the loss due to corrosion of metals in the United States, according to Dr. Gustav Egloff, of the Universal Oil Products Company, is one billion dollars a year. When one considers that the country's business is estimated at 90 billion annually, the heavy toll this scourge takes is realized. In the American oil industry alone, the corrosion bill for 1928 is estimated at 135 million dollars. This is equal to a levy of 1 cent on each gallon of gasoline consumed.

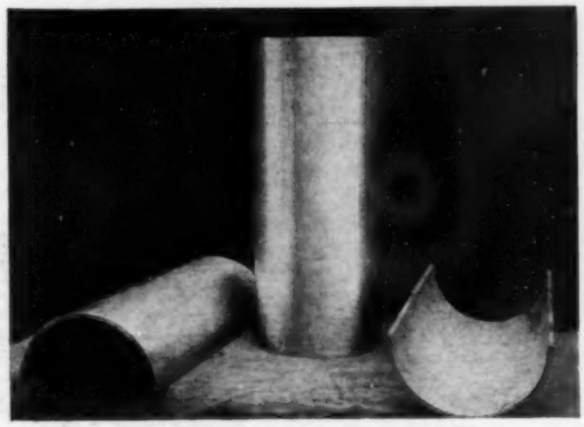
Because of the variety of processes used for the production of paper and the chemicals used in each, the pulp and paper industry is in an unfavorable position as regards corrosion. J. D. Miller, of the York Haven Paper Company, reported a year ago that, as the result of a canvass of the sulphite mills the estimated value of the corrosion loss, per year per ton daily production, was $98.75. The labor charges and loss in production are not included in this figure. This means that the annual corrosion bill of many plants would be between $50,000 and $75,000. But the sulphite mill is not the only one which has its corrosion losses. A soda mill making 50 tons of book paper daily spent in 1929 approximately $12,000 for replacing valves and fittings. This mill purchased in that year 17,390 ft. of black and galvanized iron pipe in sizes from ½ in. to 15 in., as well as 625 valves. And in addition to the losses from chemical corrosion, there is a large loss due to atmospheric corrosion, which shortens the life of tanks, equipment, and buildings.

There are three types of corrosion-resistant materials of construction that are particularly interesting at this time. They are alloys, plastics, and carbon.

During the past two or three years the 18 per cent chromium, 8 per cent nickel, ferrous alloy has become increasingly popular among sulphite mill men, and today its applications include centrifugal pump casings, shafting, impellers, and valves. Seamless tubing of this metal has been adopted in many mills for handling hot sulphite liquor, piping for sulphur-burning equipment, and in some instances for sleeving to cover shafting where it runs through a corrosive solution. Plates on the top locking covers of the digesters, and blow-pit drainer bottoms made of the alloy have been almost universally adopted. And other applications include blow-pit linings, circulating systems, flow lines, acid tanks, acid heaters, and beater bars.

For several months three or four experimental and one small commercial sulphite digester made of the "18-8" alloy have been in operation. It is reported that in Finland there are two or three sulphite digesters lined with this alloy that have given satisfactory service for several years.

There probably is little doubt left in the minds of most engineers that the "18-8" alloy is valuable for resisting corrosion in sulphite mills. Engineers realize that in the cases where equipment, fabricated of this metal, has failed in a short period of time, the failures have not been due to the chemical formula of the alloy but to lack of knowledge of its characteristics by producers, fabricators, and paper-mill engineers. Improper heat-treatment and stress, resulting in intercrystalline corrosion and disintegration of the metal, and porous castings account for most failures. An example of this is a circulating system installed in a Wisconsin pulp mill which failed after two months' service because the fabricator did not follow foundry instructions in connection with bending of the pipe and elimination of stresses during erection. The foundry subsequently fabricated the entire circulating system at its plant to actual blueprint dimensions, so that it could be erected without any undue stress, and the material functioned perfectly for a period of two years, at the end of which time there was no evidence of corrosion.



Sleeves of Allegheny Metal Used for Covering a Shaft Running in a Corrosive Solution

The straight "18-8" alloy first placed upon the market may not be the most resistant alloy to sulphite corrosion that may ultimately be attainable. Producers have attempted to improve sulphite resistance by modifying the chemical formula. An alloy with a few per cent of molybdenum, such as the Krupp interests have developed, has been in use in many mills for some time and it is generally supposed to be superior to the straight "18-8." There are some cases where its additional resistance to corrosion justifies the added cost. Recently this alloy has been still further modified by a reduction in the carbon content to less than 0.07 per cent. It is claimed for this material that it requires no heat-treatment after welding.

In the interest of further improving the high-chrome, high-nickel alloy for use in resisting the chemicals encountered in the sulphite industry, a steel manufacturer has brought out an alloy which contains slightly higher percentages of both of the above elements. The table gives the results of tests on this modification which V. B. Browne and C. A. Scharschu, of the Allegheny Steel Company, have made. Since these were the results of only a few laboratory tests they cannot be considered conclusive proof of the suitability of the alloy for use in resisting sulphite corrosion; however, these tests are additional evidence that some modification of the "18-8" alloy can be expected eventually to supply the industry with a material of construction that will be an improvement over any now available.

In addition to chrome-nickel alloys, carbon is one of the most recent and interesting materials to be used

Based on a paper presented before the Technical Association of the Pulp and Paper Industry, at the annual meeting, Feb. 20, 1931.

for the construction of process-industry equipment. It is being used successfully in pyrolytic process phosphoric acid, contact sulphuric acid, and other heavy chemical plants. At first glance a carbon might seem to be a material which could play no part in pulp and paper manufacture, but it has been found that the low coefficient of friction, chemical inertness, and the wide range of sizes and shapes in which it can be made fit it for service in a number of places in this industry.

Table I—Corrosion Resistance of a "20-10" Chrome-Nickel Alloy

1 Per Cent Sodium Bisulphite — 3 Per Cent Sulphurous Acid
Temperature, 300 deg. F. Pressure, 50-55 lb. per square inch

C	Cr	Ni	Mo	Loss per Square Inch per Hour
0.13	17.39	8.39	...	0.511 milligrams
0.12	20.39	10.76	...	0.182 milligrams
0.13	17.74	8.30	2.0	0.347 milligrams

Most of the mechanical applications of carbon revolve about the coefficient of friction and expansion or lubricating value and its ability to be ground into a closely fitting joint. These qualities come into play in the use of carbon rings for obtaining tight joints in steam connections to paper-machine drying cylinders. Each joint contains a carbon ring about 7 in. O.D. x 4 in. I.D. x $\frac{5}{8}$ in. thick, fitted to the journal of the revolving cylinder and bearing against a bronze or brass ring on the stationary journal bearing, through which steam is admitted to the cylinder. Sometimes a pair of carbon rings is used instead of a metal to carbon contact. These mated rings are said to assure a very close fit by revolving against each other under spring compression, so that there is not the slightest escape of steam under normal working pressures. One of the largest paper-mill machinery manufacturers, who holds a patent on this application of carbon, has used these rings for several years.

A recent development in paper-machine operation is the proposed substitution of carbon for wood suction-box covers. The carbon covers follow the same general pattern as wood covers, being made of fitted sections of carbon plates perforated with holes over the suction area and bolted to the box rails.

Reasoning from the analogy of the low wear on copper commutators by carbon motor brushes, it is believed that the use of carbon suction-box covers will considerably increase the life of Fourdrinier wire and result in other advantages, such as reducing driving power consumption and suction-box maintenance costs.

This application has been in course of evolution for several years, but its actual commercial application has awaited the development of a practical machine for initial and periodical surfacing of the carbon covers. The new planing machine is said to produce an absolutely true and highly polished surface on the cover. A complete set of these carbon suction-box covers is now undergoing a trial in a mill of one of the large paper companies, and so far the results obtained look very favorable.

Digester linings are the object of considerable concern by pulp producers. The ceramic linings now in use must be renewed at frequent intervals ranging from six to nine years, because of their susceptibility to spalling and chemical disintegration. This imposes a troublesome maintenance problem, because of the high cost of replacements and interference with production. It is believed that carbon is entirely unaffected by the chemical reactions occurring in pulp digesters, and that its elasticity and unusual resistance to thermal shock are comparable to those of ceramics. For these reasons, a lining composed of carbon bricks set up in a manner quite similar to that of the present practice should render a life equal to that given by ceramic materials.

Complete carbon digester linings have not as yet been installed, but the result of trials under accelerated and actual conditions have been so favorable that entire carbon linings are being actively considered for both sulphite and kraft digesters. Several large-size patches of carbon bricks inserted into the ceramic linings of sulphite and kraft digesters have been under close observation for upward of a year. To date there has been no evidence of corrosion or erosion on the surfaces of the carbon patches, which are unchanged. Also, the sharp machined edges of the carbon bricks attest to a complete absence from spalling, which might be induced by thermal stresses. Samples of carbon blocks subjected to highly accelerated digester conditions for 200 or 300 hours exhibit no change in their condition, beyond a moderate gain in weight, due to the absorption of calcareous salts.

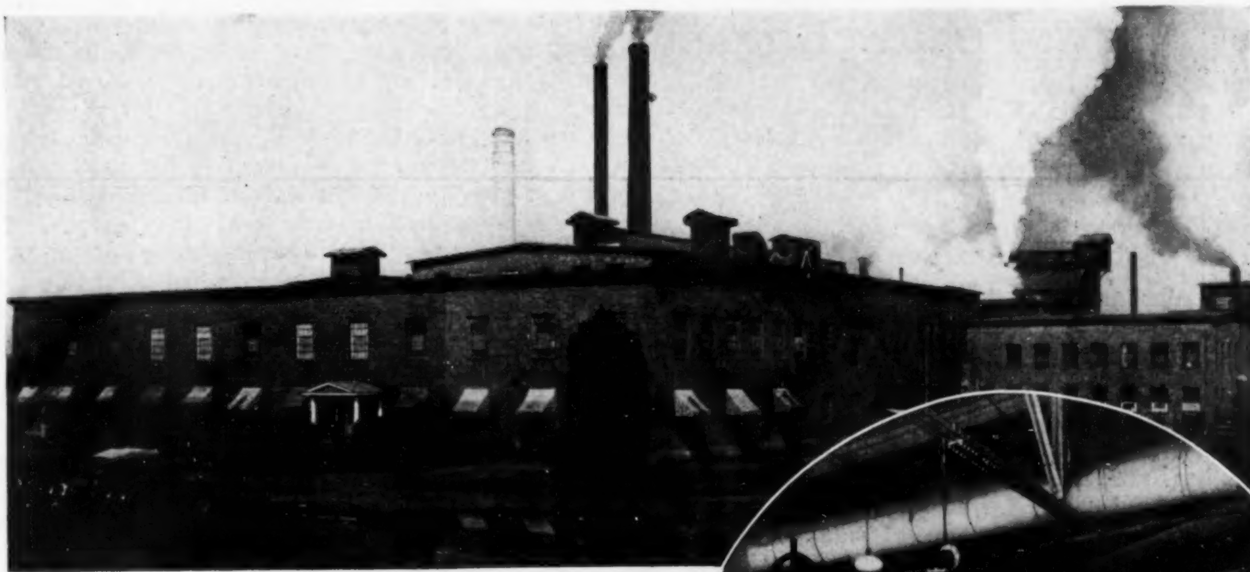
The promising results obtained so far in pulp digesters have suggested the use of carbon in other pieces of equipment operating under more or less difficult corrosion conditions in pulp and paper mills. Among these are blow-pit linings, vomit stacks, blow-pit strainers and sills, sulphite liquor-storage tanks, and stock chests.

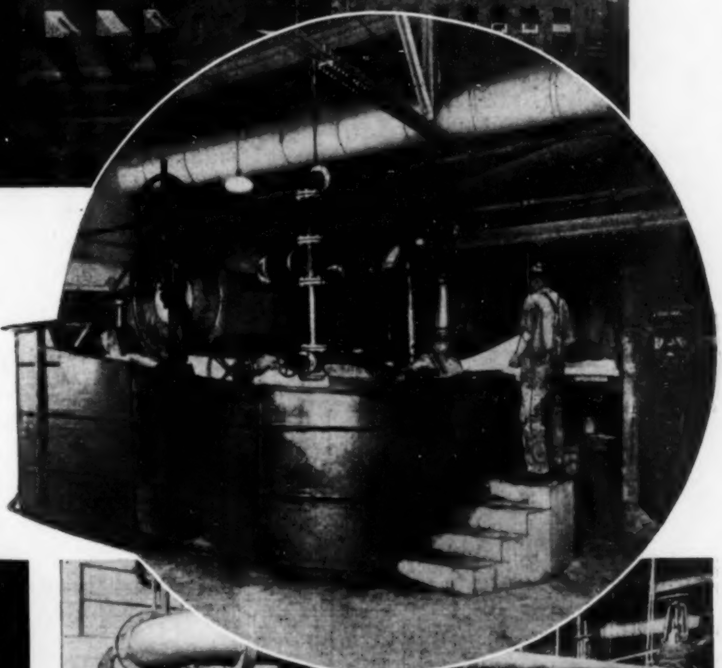
Molded plastics are not strangers. The phenolic resin type has been in use 15 to 20 years, and during the past few years numerous new types have been developed. The number of applications for these molded materials is growing by leaps and bounds. The main applications are tableware, clock cases, cosmetic cases, meter cases, and automobile specialties.

But these materials are finding their way into the plants of the process industries as materials of construction. Their chemical inertness and physical properties make them suitable for many parts of equipment. Because of its ability to resist moisture, warping, chipping, and erosion, Micarta is used for doctor blades on press sections of the wet end of paper machines. These scraping blades hug the underside of the roll and knock off bits of paper which might mar its brass smoothness. Felt wipers are eliminated. This material has been in service over three years and the wear to date indicates that these blades will last approximately eight to ten years. Another plastic, Bakelite, is in use in pulp mills for impellers in washers, for gears, and other purposes.

Roof-Support Bolt, Used to Suspend Hood Over Paper Machine, Protected From Corrosion by Bakelite

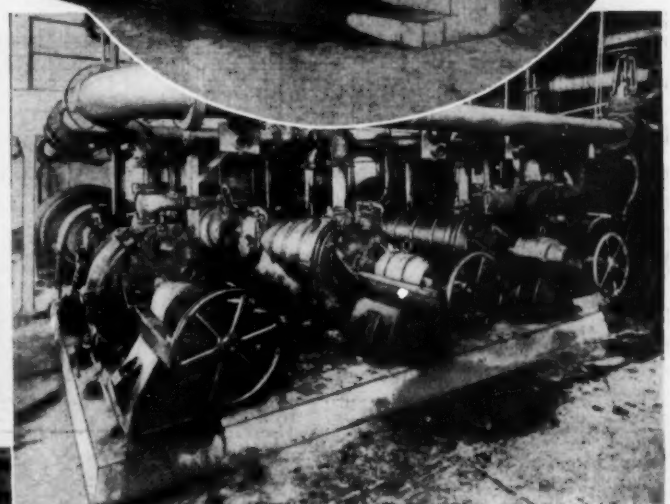
In closing, it should be emphasized that the development of new materials to resist corrosion, and their adaptation to the requirements of a particular industry, demands the hearty co-operation of manufacturers and users alike. This is necessary, since the laboratories have not as yet developed methods of tests that can be relied upon to do more than indicate whether a material will be suitable. The only truly reliable method is an actual mill test on a commercial scale, and to do this the manufacturer, obviously, needs the assistance of pulp and paper mill engineers.

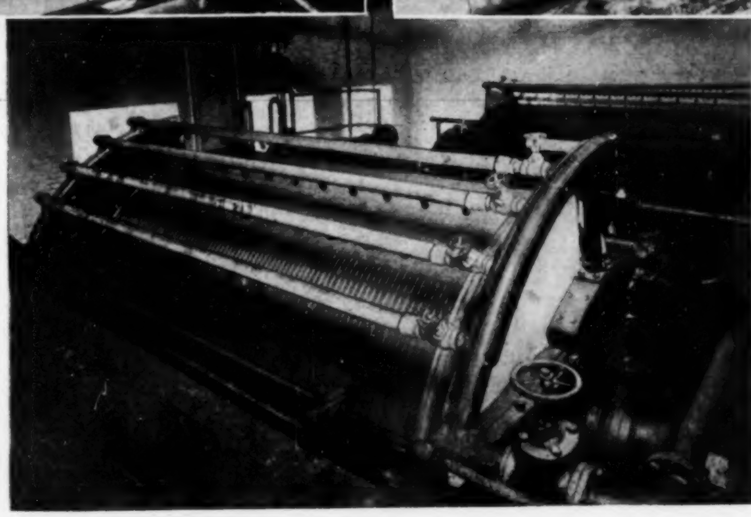




Paper Making in a Modern Mill

Plant of the Mead Fibre Company is shown above, and on the right a beater for mixing and preparing the materials for paper making





Above—The paper machine room from the "wet end," showing the "wire" or traveling table where the sheet of paper is formed. The hoods above the drying rolls can be seen in the rear

Above—A Jordan refiner used in the final step in preparing paper stock to make it suitable for the proper construction of the sheet of paper. A continuous vacuum washer used for washing pulp is shown on the left

Petroleum Engineering In Review

EDITORIAL STAFF REPORT

Editor's Note: Each year one session of the annual meeting in New York of the American Institute of Mining and Metallurgical Engineers is devoted to a review of significant engineering developments in the petroleum industry. This year three papers summarized trends in the important fields of production engineering, refining, and economics which seem of particular interest to the chemical engineer. These are briefly reported here.

CHEMICAL engineering, in the past, has played a relatively minor rôle in the oil fields. To be sure, problems of corrosion, gasoline recovery, natural gas conservation and utilization have all called for attention from the chemical engineer. More recently a broad field is opening up in the handling of the mud-laden fluids used in connection with rotary drilling of oil wells. As W. K. Whiteford, production superintendent of the Barnsdall Oil Company, of Tulsa, pointed out, the use of mud in rotary drilling is not particularly new, but up to this time there has been no concerted effort to establish physical standards for mud fluids or the application of better mud practices. He reports:

"Methods for treating the mud to secure the desired properties have brought into use several pieces of equipment familiar in mining practice. Vibrating screens and classifiers have been used successfully in conditioning mud-laden fluids for drilling purposes. The importance of using an adequate mud in the prevention of blowouts, lost circulation, stuck drill pipes, protection to upper formations of water, gas, or oil, and the elimination of excessive wear on bits, cones, bushings, and slush pump parts gave the engineer his greatest opportunity to apply sound engineering practice to the production of oil."

> **"Chemistry and engineering are now allied in petroleum refining more closely than ever before. Through this alliance it is expected that many new products will be developed which will materially assist in increasing profits, despite prevailing low prices. Overproduction of crude oil and large stocks of gasoline do not hold much promise of better prices. Hence the development of byproducts should receive the attention of every one in the industry."**
>
> **—H. W. Camp.**

H. W. Camp, manager of refineries, Empire Gas & Fuel Company, Tulsa, Okla., showed how the total gasoline yield per barrel of crude oil increased from 39.6 per cent in 1929 to 41.99 in 1930. He attributed this largely to the cracking processes, greater throughput, mechanical devices such as regulating equipment for automatic control of furnaces, liquid flow, pressures and temperatures, the development of furnaces using radiant heat tubes, pre-heaters, and flue-gas-circulating systems. He pointed out that corrosion of cracking chambers and other equipment has been retarded by the use of chemical treatment, ceramic material linings, and alloy steels. Nickel, chromium, and vanadium have shown particularly interesting possibilities.

Electric welding, seamless steel tubing, and many improvements in pipe-line construction have made it possible and highly advantageous to transport petroleum products by this method. Lines with operating pressures over 1,000 lb. per square inch are now under construction. It is not surprising that gasoline should be transported by this method, and at a much lower cost than by rail.

An interesting feature in refrigeration recently developed involves the use of dewaxed oil for the cooling medium in place of salt brine. The advantages of this method, according to Mr. Camp, are that it reduces corrosion and increases ease of operation. The oil for dewaxing is passed in series through a battery of chillers, where it is contacted with the dewaxed oil. The last of the chillers are of the direct ammonia expansion type which reduces the oil to approximately 40 deg. F., whence it passes directly to the centrifuges. Dewaxed oil from the centrifuges is further chilled by direct ammonia expansion, whence it passes through the chillers to storage. Very efficient exchange of refrigeration is accomplished at minimum cost.

Referring to the interesting possibilities through the extension of the hydrogenation process, Mr. Camp said it is not at all unlikely to expect that plants could be designed with balanced skimming, cracking, and hydrogenation facilities to manufacture whatever products are most desirable and in whatever percentages they are desired. It is not too much to expect the refinery of the future, he said, to be a completely balanced unit. Producing gasoline, fuel oil, and coke, it has an abundance of fuel available for operation of gas engines, steam plants, and complete electrical power units. A recently built refinery near Denver, Colo., is almost entirely operated by electrical power.

In some of his recent studies of the economics of petroleum production and consumption, Joseph E. Pogue, consulting engineer, of New York City, has brought out some interesting relations between the potential supply of crude oil, as indicated by the initial output of newly drilled wells, and the existing quantity and price of oil in storage. Mr. Pogue concludes that this potential has the economic effect of an inventory, the effect being approximately one-half that of the potential converted into actual production. He finds that the price of crude oil correlates with the actual inventory of oil in storage corrected by adding the inventory equivalent to this potential. His further studies led him to two important conclusions: (1) If all drilling ceased, the crude oil potential would be sufficient to maintain producition in balance with existing demand for 28 months. (2) If all restrictions were removed and the oil could be physically handled, the crude petroleum output of the United States in 1931 would be 1.5 billion barrels. In such event, the price of Mid-Continent crude oil would have an indicated decline to 10 cents per barrel.

These studies of Mr. Pogue are of particular interest to chemical engineers, because they represent an application of economic analysis into a field where only empirical considerations had previously been accepted. To extend this type of thinking into other of the process industries holds promise for equally important results.

A Building Material to Resist Corrosive Atmospheres

By E. C. RACK
Engineering Department
Johns-Manville Corporation
New York City

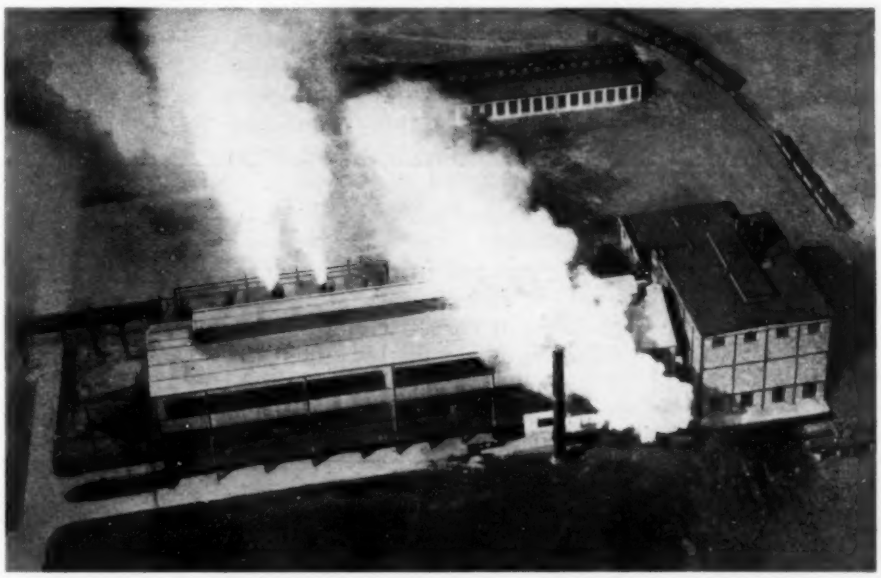
MATERIALS of construction for both buildings and equipment for chemical engineering processes are particularly interesting at this time. To a greater or lesser degree, every industry has become conscious of the enormous losses in the corrosion of metals. New materials are being developed and old ones adapted for the purpose of resisting corrosion. A material composed of portland cement and asbestos fiber, Transite, is successfully used in corrugated sheet form as a building material where it is necessary to withstand the action of an unusually severe corrosive atmosphere.

When it was decided to increase the size of the incinerator plant at the Baltimore works of the U. S. Industrial Chemical Company, manufacturer of solvents for the lacquer industry, from two to six furnaces, which required lengthening of the building, it was decided to cover the entire building with the cement-asbestos sheets. This material has now been in service for over five years and shows no sign of weakness, despite continual exposure to the action of the gases resulting from a combustion of a concentrated waste product, which are particularly corrosive when combined with moisture.

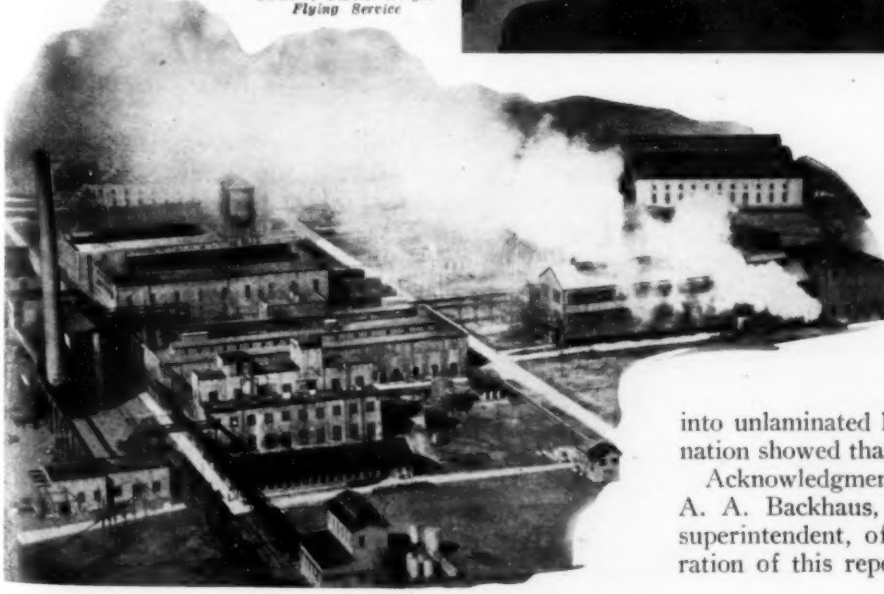
An explanation of the chemical processes in the buildings will show why it was important to use a building material that would resist particularly active corroding media. Molasses-fermentation slops are pumped from the Curtis Bay plant of the parent concern, the U. S. Industrial Alcohol Company, to the chemical company's plant. The waste product is evaporated and then burned in special furnaces. Six large incinerators receive the evaporated molasses residue under pressure, through openings in the bases, in the form of a spray. As this material burns, it drops down to the bottom of the incinerators in the form of clinkers. From here the clinkers are conveyed to another building a short distance away, where they are ground into a powder and dumped into storage bins.

Gases from the incinerators pass through waste-heat boilers to dust collectors, where the solid matter is removed and the gases are discharged into an ammonia-recovery system. A 1 to 10 per cent solution of sulphuric acid is used in the scrubbing towers, and the resulting product is ammonium sulphate. The waste-heat boilers and dust collectors are in the same building with the incinerators, while the ammonia-recovery system is located in a building about 6 ft. away.

A total of 42,000 sq.ft. of corrugated Transite sheets was required to cover the monitor, main roof, and sides of the incinerator plant. Sheets were laid with a two-corrugation side lap, and a 6-in. end lap. The side and end laps of the roof sheets and all exposed bolt heads were laid in putty to insure a water-tight job. The maximum spacings for the purlins and girts were 48-in. and 60 in. respectively. Louver blades of the same material were used on the sides of the monitor, through which ventilation is provided.



Transite Sides and Roof of Incinerator Building Resist Corrosive Atmospheric Conditions



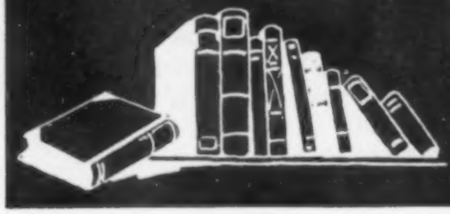
Baltimore Plant of the U. S. Industrial Chemical Company

Courtesy Curtiss-Wright Flying Service

Five and one-half years of service at this plant has proved that flue gases from the incinerators in the presence of moisture do not affect portland cement and asbestos fiber molded under tremendous pressure into unlaminated homogeneous sheets. A recent examination showed that this material is still in good condition.

Acknowledgment is made of the collaboration of A. A. Backhaus, vice-president, and F. C. Hettinger, superintendent, of the chemical company in the preparation of this report.

Chemical Engineer's Bookshelf



Organic Hydrogenation

Hydrogenation of Organic Substances. By *Carleton Ellis.* Third Edition. D. Van Nostrand Co., New York City, 1930. 986 pages. Price, $15.

Reviewed by S. D. Kirkpatrick

If one's acquaintance with hydrogenation dates from its recent and spectacular rôle in the petroleum industry, one is likely to be considerably surprised at the enormous volume of literature that has already accumulated in this relatively new field. And if one has occasion to search for a specific reference or to trace the development of some particular phase of hydrogenation through the maze of patents and journal articles, one will very soon be impressed by the yeoman service of Mr. Ellis in abstracting, compiling, correlating, and interpreting the literally tens of thousands of citations. Now that this great work has reached its third edition (the first appeared in 1914 and the second in 1919), it becomes immediately apparent that hydrogenation is a new subject only in its greatly broadened application.

These new developments have had the author's special attention in the present revision. The high pressure, high-temperature technology involved in the hydrogenation of coal and petroleum oils and in the production of solvents by the hydrogenation of carbon monoxide, are the subjects of comprehensive chapters that attempt a complete review of all published work. Nor has the growing field of application for hydrogenation in synthetic organic chemistry been neglected in the present revision.

Four chapters on hydrogen production, and as many on its purification and handling are likely to prove one of the more valuable features of this book. The hundred or so competitive processes and sources for this important raw material for chemical industry are cited in more or less detail, although, unfortunately, without any critical attempt at comparative evaluation. For the reader who searches for this sort of treatment, the present work may prove disappointing. On the other hand, its very great and real value is as a reference source in which one may confidently expect to find complete, although somewhat condensed, coverage of all important developments in the field of hydrogenation. In practically every case there are patents or journal references that will help the reader to locate the more detailed treatment in the original sources.

Obviously the usefulness of such a book as this depends to a considerable extent upon the accuracy and thoroughness with which it has been indexed. That the author realizes the value of such an index is evident in several ways. For example, each paragraph of the entire book is numbered—from 100, the opening paragraph of Chapter I, to 6,362, the concluding paragraph in the addenda that follow the last chapter. The author and subject indexes, covering in all 87 pages, are unusually detailed and, because of the numbering of the paragraphs, the text references can be located quickly and accurately.

The chemical and engineering professions are indebted to Mr. Ellis for his herculean effort in codifying the enormous mass of information and data on hydrogenation. That he has been able to do it promptly as well as thoroughly is evidence of good journalism; he well deserves to capitalize on his timely work.

Explosives and War Gases

Explosifs, Poudres, Gaz de Combat. By *Paul Pascal.* Second Edition. 1930. Librairie Scientifique Hermann et Cie., Paris. 320 pages. Price, 60 F.

Reviewed by E. M. Symmes

No ESSENTIAL modification has been made in this second edition, but chapters on poison-gas defense and gasoline anti-knock agents have been added. And although data are given on processes developed and used outside of France, some omissions stand out prominently. For example, no mention is made of the wide use in dynamites of nitrated polymerized glycerine or nitroglycol to prevent freezing, the use of low temperature in nitration to improve yields, the use of anything but water for nitrator refrigeration, the use of fluorides or the like to facilitate separation of nitroglycerine from spent acid, while the use of mechanical stirrers in nitration is condemned as too dangerous in America, in spite of very many years of satisfactory operation. Stirrer shafts do not pass through the cover by a hydraulic joint, but through a plastic mass of asbestos and petroleum jelly.

Unfortunately, only smokeless powder nitrocellulose is described, and viscosity alterations are practically ignored. While considerable space is given to the Thomson displacement and centrifugal nitration processes, no mention is made of the much used mechanical dipper, or of stainless steels in nitrocellulose manufacture.

Casting trinitrotoluene into slabs in molds and powdering by hand in France is quite a contrast to our method of graining in kettles such as are used for ammonium nitrate. Black blasting powder is made without hydraulic presses, except cannon powder, which with brown prismatic cannon powder could well be omitted, because obsolete. The wet method of manufacture in Sweden and Chile is not described.

Nitrocellulose for gelatin dynamite requires 30-45 minutes to colloid with nitroglycerine. Improvements,

now years old, to give quick colloiding are not mentioned. Progressive burning smokeless powder is mentioned briefly, but the important deterrent dinitrotoluene is omitted.

The description of dynamites applies mainly to France. To give the impression that "in America there has been used widely sacks of chlorate, which are immersed just before use in a mixture of tar oil and carbon disulphide. This explosive has been given the name Rack-a-rock," without stating that it became obsolete ages ago, is an injustice, in addition to being an inaccurate description.

Chemical Principles in Metallurgy

PHYSIKALISCHE CHEMIE DER METALLURGISCHEN REAKTIONEN. By *Dr. Franz Sauerwald.* Verlag Julius Springer, Berlin, 1930. 142 pages. Price, 15 m.

Reviewed by ALLISON BUTTS

CERTAINLY in America, and apparently in Germany and other places as well, there is a growing interest in making more direct practical use of principles in theoretical chemistry which once were regarded in most quarters as being mainly of academic interest. This tendency will be stimulated by the book under review. Dr. Sauerwald's work, which bears the subtitle, "A Guide to Theoretical Metallurgy," will be valuable both in suggesting and in guiding applications of physical chemistry in extracting and refining metals. The book comes as a sort of sequel to the author's excellent "Lehrbuch der Metallkunde," published only a year and a half ago, and is an exposition of a phase of metallurgy which kept recurring during his preparation of that work, but which it seemed best not to develop therein.

The first part of the book, comprising about a quarter of the whole, reviews the physical-chemical laws under discussion, including chemical equilibria and their division into homogeneous and heterogeneous systems, the phase rule, the Helmholtz equation, the mass-action law, Nernst's distribution law, affinity, the thermodynamics of chemical reactions, and reaction velocities. The second, the main part of the book, discusses from a quantitative standpoint the application of these laws, particularly the principles of equilibrium, affinity, and reaction velocity, to metal recovery. The third part, a briefer section, takes up some applications to specific processes, including the iron blast furnace, production of steel, zinc distillation, and electrolytic zinc.

SELECT METHODS OF METALLURGICAL ANALYSIS. By *William A. Naish* and *John E. Clennell.* John Wiley & Sons, Inc., New York, 1930. 495 pages. Price, $7.50.

THIS book covers a very broad ground in a concise manner. The authors have chosen the methods which they believe to be most practical from the standpoints of rapidity and accuracy, and have presented them in the form of simple directions, followed by extensive bibliographies. Preceding the main part of the book there are sections on sampling, qualitative analysis, and general analytical procedure. Then the determination of each element is taken up in alphabetical order, followed by the analysis of the commercial metals and alloys, and then by chapters on the analysis of ores, slags, intermediate products, refractories, and coal. Finally there are chapters on electrometric titration, mineral analysis, and spectrographic analysis.

Electrolysis of Aqueous Solutions

DIE TECHNISCHE ELEKTROLYSE WÄSSERIGER LÖSUNGEN. Part I, Handbuch der Technischen Electrochemie. Edited by *Victor Engelhardt.* Akademische Verlagsgesellschaft m.b.H., Leipzig, 1931. 613 pages. Price, 58 M.

Reviewed by B. H. STROM

FORTY years' service in the electrochemical department of Siemens & Halske, a period including the entire development of technical electrochemistry, makes Dr. Engelhardt eminently qualified for the ambitious undertaking of editing a handbook dealing with every important branch of this industry. Electrolysis of aqueous solutions, of which this volume is the first part, will be followed by treatises on electrolysis of fused salts, electric furnace practice, electrochemical gas reactions, electro-osmosis and cataphoresis, and accumulators. In his work the author has had the good fortune to enlist the service of men prominent in the field, such as H. V. Steinwehr, contributing the opening chapters on theoretical electrochemistry; W. Pfanhauser, writing on iron; E. Liebreich, on manganese and chromium; V. Hybinette, on nickel; W. Schopper, on bismuth, lead, and mercury; C. L. Mantell, on tin; Georg Eger, on cobalt, zinc, and cadmium; and R. Gross, on electrical equipment.

The opening chapters, dealing with the fundamental theories of electrolysis, and with electric machinery, cell-room equipment, and instruments, should be of value to operators whose knowledge of this phase of practice too often is incomplete and fragmentary. More emphasis might have been placed on the development of lead-lined concrete cells, now replacing wooden cells. Chapters on iron, tin, bismuth, antimony, and some of the minor metals, present developments of recent date and offer much new and interesting information, even though some of the processes described have not yet reached the commercial stage.

A comprehensive picture is presented of the electrolytic nickel process from the early days of its development. An interesting fact may be noted, that no fundamental changes have been introduced since the early work of Hybinette. Even the boric-acid content of the electrolyte, which for a time was carried at 30 to 40 gr. per liter, is now back to the figure originally specified, about 20 gr. per liter. The higher concentration was found to cause difficulties by precipitation of basic salts. Refinements in the cementation process and introduction of mastic-lined concrete cells are among the important improvements of later years.

In his discussion of the electrolytic-zinc process and in describing important plants using the high-current density and the low-current density methods, Dr. Eger displays first-hand knowledge of his subject. Some of his information about what he terms the Anaconda process, however, is not up to date. The power factor given, for instance, is too low. Even as far back as five years ago, 90 per cent ampere efficiency was no longer considered satisfactory, unless a material containing an unusual quantity of impurities was handled. Germanium was discovered at the Anaconda plant in Great Falls early in 1928, and large tonnages of a material containing as high as from 0.05 to 0.10 per cent of this impurity have been treated successfully from that time. Increasing efficiency in the purification practice, dating back several years, has resulted in a steady improvement in the quality of the zinc, until for more than one

year the grade has exceeded 99.99 per cent. Such work, and not haphazard benefits derived from iron dissolved in re-treatment of residue, as intimated by the author, is responsible for the improved results of later years, when an ampere efficiency approaching that obtained in copper refining is often attained.

The electrolyzing cells used at the zinc plant in Trail, B. C., are of concrete, lined not with asphalt, as stated, but with a mixture of sand and sulphur. In the electrolytic cadmium process, stationary cathodes are now universally used, and the tendency is toward increasing current density.

The text is accompanied by numerous charts, tables, and illustrations. A comprehensive index, bibliography, and list of patents make the book valuable as a reference work. The appearance of succeeding volumes, promised for an early date, is anticipated with a live interest.

Pigment Technology

The Manufacture of Lakes and Precipitated Pigments. By *A. W. C. Harrison,* Leonard Hill, Inc., London, 1931.

Reviewed by R. K. Hench

A SHORT practical text on the manufacture of the various types of lakes and pigments generally used by paint, printing ink, and allied industries, this book emphasizes a phase of color manufacture that is not as fully considered in other texts. Instead of giving many "receipts" or formulas, which the author rightly says are almost worthless, he has stressed a more important feature: the practical details and precautions necessary in color manufacture. It is possibly too condensed in that the chemistry of various operations is not discussed, but the essential features of the subjects are covered by sufficient references to meet the average need.

The author goes into detail, with pictures and diagrams, of vat and agitator construction; and pressing, drying, and grinding machinery, a general knowledge of which is essential for an understanding of the problems of the business. A section on analytical and testing methods follows, including a short chapter on light and color in relation to pigments. The remainder of the book is devoted to the manufacture of chrome yellows, chrome greens, prussian blues, and organic lakes and pigments such as Lithol, para, and toluidine reds; alizarine lakes; and lakes from acid and basic dyestuffs.

Although the experienced color chemist possibly will have more complete information on his various processes than can be incorporated in any general text, the book will no doubt be of valuable assistance, especially to those not so familiar with the practical manufacture of color.

Recently Arrived

Elements of Successful Organization Engineering. By *Henry S. Dennison.* McGraw-Hill Book Company, Inc., New York, 1931. 204 pages. Price, $2.

TO THE man interested in the elements of successful relationship of the personnel of an organization this book will be particularly interesting. The author, a former president of the Taylor Society, has a fertile field in the Dennison Manufacturing Company, of which he is president, in which to study the human materials of an organization. Men are living together and working together in organized groups more and more. The problems that arise, such as friction, team-work, leadership, loyalty, training, and education, are given brief consideration here. In the chapter on the structure of the organization, Mr. Dennison emphasizes that proper structure of organization is sometimes undervalued, that the specific purposes which organizations are created to serve are almost as widely varied as their membership, that outside the organization there is also its environment affecting it and affected by it.

Organization engineering has to face at the outset the fact that the complication and variations of human nature present to it problems which it cannot now hope to solve with exactness. Yet, because these problems are with us in increasing numbers in present-day life, a growing understanding of their fundamental elements must be sought.

The Chemical Age Year Book, 1931. *The Chemical Age,* Bouverie House, London. 159 pages. Price, $2.50—The annual combination of interesting facts, tables, lists, and calendar that this British periodical customarily prepares.

Le Génie Civil. Special issue celebrating the 50th anniversary of foundation. *Le Génie Civil,* Paris. 236 pages—This issue, endeavoring to cover the development of the principal industries during the last 50 years, shows no fear of the task but proceeds to make a highly complete review. Chemical engineering finds its place among the other sciences and professions, but the real excellence of this issue lies in the picture it presents of what was going on contemporaneously in the other industries.

Jahresbericht VIII, der Chemische-Technischen Reischsanscalt, 1929. Verlag Chemie, G.m.b.H., Berlin. 244 pages. Price, 18M.—Brief report of the institute's scientific activities during 1929 and the work accomplished by the various technical sections. These papers include work on hazards of chemical materials, cellulose chemistry, explosives, welding, metal corrosion and protection, and testing of materials occurring in the chemical industry.

Massecuite, Molasses, and Sugar. By *A. L. Webre.* U. S. Pipe & Foundry Co., Burlington, N. J.—The author has here compiled information used in connection with his work in Cuba to facilitate future work at the pan station for technologists. It is replete with tables of calculation and diagrams.

Treatise on Leather Belting. By *George B. Haven* and *George W. Swett.* American Leather Belting Association, New York City, 1931. 249 pages. Price, $1.50—At a time when power transmission and its relation to design in the chemical plant is a growing factor, it is fortunate that the belting industry has put its engineering into this orderly accredited form. The text is concerned not only with belting proper but to a much larger extent with its relation to drives, idlers, pulleys, bearings, and speed ratios. Tables and specifications accompany the text.

Deutcher Färberkalendar, 1931. A Ziemsen Verlag, Wittenberg, Germany—This curious little compendium, published annually for the last 40 years for the dyeing industry, contains a number of technical articles, a calendar, table of dyes, and a buyer's guide.

Statistical Information on aluminum, lead, copper, nickel, mercury, silver, zinc and tin. Published by the Metallgesellschaft A.G., Frankfurt, Germany. 91 pages—An excellent review of metal markets up to 1929. Marketing, production, import, and export information is broken down according to countries over a long span of years; prices and tariffs accompany this main body of the work.

Gemelins Handbuch der Anorganischen Chemie, Eisen, A 3, Verlag Chemie, G.m.b.H., Berlin. 263 pages. Price, 32M (by subscription)—Continuation of the handbook's new section on iron, including a discussion of its corrosion properties and production in crude form.

Selections from Recent Literature

Processing Fabrics. Otto Mecheels. *Melliand Textilberichte,* February; pp. 123-4. Among the chemical agents for imparting to textiles desirable handle, sizing behavior, and other properties, the vegetable lecithin now produced from soy beans has a considerable range of applicability. It is an excellent emulsifier and softener, for which purposes the ordinary yellow emulsion in water can be used without yellowing the goods. For sizing and like treatments, the yellow lecithin can be bleached. It is not stable in acid baths, but serves well in neutral and alkaline liquids. The behavior in soft water is particularly noteworthy, but waters with hardness up to 15 deg. d. can be satisfactorily used. An aqueous emulsion of soy-bean lecithin makes an excellent mill oil for spinning either cotton or wool; added to throwing baths, it makes silk soft and lustrous, and has a certain amount of weighting effect. It enhances the luster and feel of rayon, and permits lower alkalinity in liquor for the pressure bucking process. Bleached lecithin prevents stiffening in the sizing of cotton; if used without bleaching, it imparts a greenish cast which is desirable for some purposes. Experiments have been made on the use of lecithin in printing pastes, but results are not yet sufficiently conclusive to warrant predictions. In competition with other materials with like properties and uses, lecithin may be expected to have a cost advantage in some cases, and quality advantages in others.

Oxidizing Paraffin Electrochemically. I. A. Atanasiu. *Berichte der deutschen chemischen Gesellschaft,* Feb. 4; pp. 252-60. In all the work that has been done on the production of fatty acids from paraffin, the use of nascent electrolytic oxygen has not received the attention it deserves. Limitations imposed by operating requirements are such that several of the possible expedients for oxidizing water-insoluble substances are excluded, and recourse must be had to emulsification of the paraffin in the anode solution. The best results have been attained by using a lead vessel both as anode and electrolyte container. The cathode is lead, inclosed in a porcelain cell; the electrolyte is sulphuric acid. Oxidation is easily effected, with the aid of a catalyst such as potassium dichromate or cerium sulphate. There is some evolution of carbon dioxide, and formation of unsaponifiable matter, but the major oxidation product comprises fatty acids. The best yields are attained by a system of successive oxidations with short-time intervals, the products being removed after each step. Soft paraffins oxidize more readily than hard, but give a lower yield of fatty acids and more unsaponifiable matter. The oxidation is purely chemical, but is not a direct reaction between oxygen and paraffin; it seems rather to involve the two reactions: oxygen-catalyst, and catalyst-paraffin. Best yields are obtained at low-current densities, using partially oxidized paraffin as the starting material. The electrochemical method has the advantages of not being complicated by formation of hydroxy acids and of having only small losses by evolution of volatile products. The kind of paraffin used has a large influence both on the quantity and the kind of fatty acids obtained.

Corrosion in Dyeing. Rud. Müller. *Melliand Textilberichte,* January; pp. 73-6. In the fabrication of dye vats and the like from Monel metal, it should be remembered that much of the advantage of corrosion-resisting properties inherent in a metal can be sacrificed by faulty construction. Some instructions are therefore given for the steps to be followed in lining old or new wooden vats, and in fabricating metal vats for use in processing textiles. For Monel metal linings, the principal considerations are snug fit (to avoid damage due to vibrations and other deforming influences on areas of unsupported metal) and adequate corrosion resistance in the seams. Choice of solder is particularly important; a soft solder and a hard solder are specified, which are suitable for use in Monel metal dye vats. Drawings are shown of the proper design of single and double seams for joining the metal, both horizontal and vertical joints being shown and discussed. Autogenous welding is readily applicable to Monel metal; it is superior to the ferrous alloys in freedom from cracking and bursting of welds. Suitable procedures are described for welding by the oxyacetylene and the electric arc methods. For soft soldering, the method is the same as for copper, and Monel metal is as easily soldered as copper. For some dyeing processes equipment must not be soft-soldered; for such cases, a low-melting (700-760 deg. C.) silver solder is preferable. Riveted seams also are suitable for some kinds of equipment. Numerous drawings are shown.

Absorption Refrigeration. R. Plank and L. Vahl. *Forschung auf dem Gebiete des Ingenieurwesens,* January; pp. 11-8. For the absorption type of refrigeration machine, the complex compounds formed between certain halides and ammonia have properties which commend them for practical use. It is not sufficient, however, that the halide have a large capacity for absorbing ammonia; it must also meet other requirements. Its own vapor pressure at maximum operating temperature must be vanishingly small; its ammoniate must be a solid even up to 150 deg. C.; complete saturation with ammonia must proceed rapidly enough for practical purposes under about 3 atm. absolute pressure, even at tropical temperatures (30-40 deg. C.); evolution of ammonia must be adequate at 120-150 deg. C. under 12-16 atm. absolute pressure; the ammoniate must not decompose in any other way than by expulsion of ammonia; the halide must not disintegrate into a fine powder when the ammoniate is formed; the apparent specific gravity of the ammoniate should be as large as possible, so that it will not occupy too much space nor have unduly high thermal conductivity. Aluminum chloride is too volatile; the ammoniates of chromium and cobalt chlorides do not decompose solely by loss of ammonia; the halides most suited to the purpose are the chlorides of lithium, magnesium, calcium, strontium, and barium. Methylamine may be used instead of ammonia to form the complex compounds. A comparison has been made of the thermal properties of the ammoniates and methylaminates of the alkali and alkaline earth metals, with the result that the two complex compounds most suitable for commercial use in refrigerating machines appear to be calcium chloride ammoniate and lithium chloride methylaminate.

Processing Carnauba Wax. Hans Nast. *Seifensieder-Zeitung,* Jan. 22: p. 55. As an example of how difficulties in the way of an industrially desirable reaction can be circumvented, carnauba wax has been successfully decolorized, although the direct action of oxidizing or decolorizing agents will not give the desired result. The crude wax, even if treated with a large excess of oxidizing agent, is still brown. A sufficient decolorizing effect can be obtained in presence of an absorption agent; but the separation of the refined wax from the absorption agent is so difficult and incomplete that this expedient is not commercially feasible. Successful decolorization could therefore be accomplished by some other device; and many attempts were made before the desired effect was obtained. The successful method comprises the use of a strong oxidizing agent, such as chromic acid or a peroxide or peracid or persalt, in presence of certain solvents or emulsification agents which probably also act to some extent as oxygen carriers. Organic acids and their esters are among the most effective media for the reaction; for example, acetic acid or ethyl acetate. Satisfactory yields of high-grade wax, of a pale yellow color, are obtained.

Roll Mills for Paint. Max Lehmann. *Farben-Chemiker,* February; pp. 75-7. The particular suitability of roll mills for paint grinding has long been known to practical paint men. It rests partly on the complexity of the paint grinding operation, in which the breaking down of coarse particles into finer

ones is not the only purpose nor even necessarily the major one. In addition to fineness of pigment particles, there must also be thorough and even distribution of pigment in vehicle, and comminution of loose aggregates of pigment particles. The roll mill is effective in all these respects. The principle of odd-speed rolls is largely responsible for this; when the idea was once conceived of running the rolls at different speeds in the early two-roll mills, and the advantage of this method over even-speed rolls was ascertained by experience, it was a logical advance to proceed to three rolls, all operating at different speeds. Odd-speed rolls superimpose on the crushing action of even-speed rolls a tearing action which greatly enhances the efficiency of roll mills in the matter of thorough mixing of pigment and vehicle, with adequate comminution of the pigment. A variation of the odd-speed principle is that in which one speed is zero, embodied in the single-roll mills, recently revived and modernized from very old designs. The single roll operates against a fixed surface. This type of mill is useful for the final grinding of certain high-grade products. Photographs are shown of single-, three-, four-, five-, and six-roll mills. At four or five rolls, power consumption begins to be a limiting factor; the six-roll mill is in reality a pair of three-roll mills operating together.

HEAT TRANSFER. Wilhelm Nusselt. *Technische Mechanik und Thermodynamik*, December; pp. 417-22. Useful though the counter-current principle may be in chemical engineering practice, there are cases in which it is not applicable and recourse must be had to the cross-current method of interchange. A formula was derived some twenty years ago for calculating heat transfer in a cross-current process; but it was based on an integration which gave only an approximation. A formula has now been worked out which is both simpler and more precise; and with its aid new calculations of cross-current heat transfer have been made. Examples are given of the use of this formula for calculating the average effluent temperature in a cross-current process, and a diagram shows the three-dimensional curves used for calculating heat transfer from the temperature gradient between inlet and outlet. A numerical table has been compiled to facilitate the determination of heat transfer in a cross-current apparatus, and another table shows the numerical relations between counter-current heat transfer and cross-current heat transfer.

SOLVENT SOURCES. S. Bakonyi-Schiaparelli. *Farben-Chemiker*, December; pp. 109-10. Of the hundreds of items now offered for use as solvents, there are scarcely a dozen which are not produced synthetically. But of the total world consumption, amounting to perhaps 100,000 tons of solvents, hardly 10 per cent is synthetic; the bulk of the output is from the fermentation industries. Chemists are prone to look askance on fermentation processes, considering them to be complicated biological processes, difficult to control, unreliable in operation, and unsatisfactory as to yield. In comparison with synthetic processes, however, it should be remembered that fermentation does not require high temperatures and pressures; it carries a lower occupational hazard (both as to accidents and toxicity) than chemical syntheses; it requires fewer steps than most synthetic procedures, and does not complicate the picture with numerous intermediate products. In the light of experience, fermentation is at least equal to chemical syntheses in the matter of operating dependability. Probably the most important advantage of fermentation, however, is the fact that the industry derives its raw material from annual crops, which are renewed as required and can be adjusted to the demand, whereas the synthetic solvents mainly go back either to coal or to petroleum: namely, to geological deposits which are necessarily limited as to location and quantity. It is to be anticipated that fermentation methods will hold even greater advantage in the future; but it is not to be expected that synthetic methods will be displaced entirely. Fermentation products include not only valuable finished solvents but also raw materials for other solvents obtainable otherwise only by chemical methods.

REFINING ALUMINUM. W. A. Plotnikow, N. S. Fortunatow, and W. P. Maschowetz. *Zeitschrift für Elektrochemie*, February; pp. 83-8. The electrolytic refining of aluminum is a useful process for obtaining very pure aluminum and for separating the metal from its alloys in scrap, borings and the like. The principal value of electrolytic refining, however, lies in the possibility of obtaining the metal from relatively low-grade ores and purifying it, at a lower operating cost than that incurred in prevailing metallurgical methods. The difficulty is in finding an electrolytic process which fully meets the requirements both of efficacy and economy. An essential factor in success is to find a suitable non-aqueous electrolyte, in which the electrolysis can be effected at a moderate temperature. In an investigation made at the Ukrainian Academy of Sciences, at Kiev, various double salts containing aluminum were studied with this in mind. The best results were attained with aluminum and sodium chlorides, which were used as long ago as 1854 for electrolytic preparation of aluminum metal. By suitable proportioning of the chlorides and proper choice of conditions, it was found possible to refine aluminum even when its iron content is very high. Iron and copper are the only cathode metals on which satisfactory deposits were obtained.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Analyses of Wyoming Coals. Bureau of Mines Technical Paper 484; 25 cents.

A Study of Refractories Service Conditions in Boiler Furnaces, by Ralph A. Sherman. Bureau of Mines Bulletin 334; 50 cents.

Economics of Crushed-Stone Production, by Oliver Bowles. Bureau of Mines Economic Paper 12; 15 cents.

Chemistry of Leaching Bornite, by John D. Sullivan. Bureau of Mines Technical Paper 486; 10 cents.

Separation and Size Distribution of Microscopic Particles—An Air Analyzer for Fine Powders, by Paul S. Roller. Bureau of Mines Technical Paper 490; 20 cents.

Limits of Inflammability of Gases and Vapors, by H. F. Coward and G. W. Jones. Bureau of Mines Bulletin 279, revised, 1930; 20 cents.

Bibliography of U. S. Bureau of Mines Investigations on Coal and Its Products, 1910-1930, by A. C. Fieldner and M. W. von Bernewitz. Bureau of Mines Technical Paper 493; 10 cents.

Nitrogen and Its Compounds, by Bertrand L. Johnson. Bureau of Mines Information Circular 6385; mimeographed.

Mineral production statistics for 1929—Separate pamphlets from Bureau of Mines on: Natural Gasoline, by G. R. Hopkins and E. M. Seeley, 5 cents; Natural Gas, by G. R. Hopkins and H. Backus, 5 cents; Barite and Barium Products, by R. M. Santmyers and B. H. Stoddard, 5 cents; and Chromite, by Lewis A. Smith, 5 cents.

Mineral production statistics for 1930——Preliminary mimeographed statement from Bureau of Mines on petroleum, petroleum products, and natural gasoline.

World Production of Natural Gasoline, 1927-1929. Bureau of Mines mimeographed press statement, dated Feb. 28, 1931.

Production statistics from Census of Mines and Quarries in preliminary mimeographed form for 1929, on: Asbestos, barite, bauxite, and asphalt.

The Moroccan Phosphate Industry, by Frederick F. Henrotin. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 330; mimeographed.

Survey of the Fertilizer Industry, by P. E. Howard. U. S. Department of Agriculture Circular 129; 5 cents.

Development and Use of Baking Powder and Baking Chemicals, by L. H. Bailey. U. S. Department of Agriculture Circular 138; 5 cents.

Industrial Traffic Management—A Survey of Its Relation to Business, by Wayne E. Butterbaugh. Bureau of Foreign and Domestic Commerce Domestic Commerce Series 39; 30 cents.

Spain—Resources, Industries, Trade, and Public Finance, by Charles A. Livengood and others. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 739; 10 cents.

The Coal Industry of the World, by H. M. Hoar. Bureau of Foreign and Domestic Commerce Trade Promotion Series 105; $1.

List of Technical Workers in the Department of Agriculture and Outline of Department Functions, 1930. U. S. Department of Agriculture Miscellaneous Publication 93; 20 cents.

Gum Copal Industry of the Netherlands East Indies, by Edward M. Groth. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 334; mimeographed.

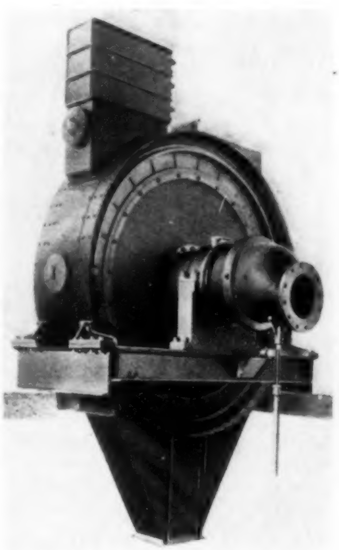
Manufacture of Insulating Board From Cornstalks, by O. R. Sweeney and W. E. Emley. Bureau of Standards Miscellaneous Publication 112; 10 cents.

EQUIPMENT NEWS
FROM MAKER AND USER

Top-Feed Filter

ESPECIALLY dry discharge on a large variety of materials which form porous cakes is said to be possible with a recently developed top-feed vacuum filter that has been announced by Oliver United Filters, Inc., 33 West 42d St., New York City. Without using either tank or agitator it is suitable for the filtering of coarse and fast-settling materials at high rates of speed. These features result from a new feeding principle, that of flowing the material on top of the drum, combined with the use of heated air to yield a product of low moisture content.

The drum of the new filter resembles standard machines in internal construction, except that it has very large filtrate passages. The usual filter medium is metal cloth. Externally the drum differs in having a flange bounding the face at each side. In some installations the entire drum is inclosed and its proportions are considerably altered, being proportionately narrower of face than the usual drum. At the top of the drum and slightly to one side is the feed box through which a controlled quantity of feed is flowed continuously onto the drum surface. If lower moisture content than can otherwise be obtained is desired, a steam-heated or direct-fired air-heating chamber is attached above the drum in the direction of rotation from the feed box. The air thus heated is drawn through the cake for a considerable part of the filtering cycle, which may occupy up to about 80 per cent of the drum circumference. Discharge, depending on the time required for the necessary drying, may take place anywhere between the bottom and a point shortly ahead of the feed box, and occurs when the vacuum is cut off. A hopper at the bottom, made of any suitable metal, catches and discharges the released cake.



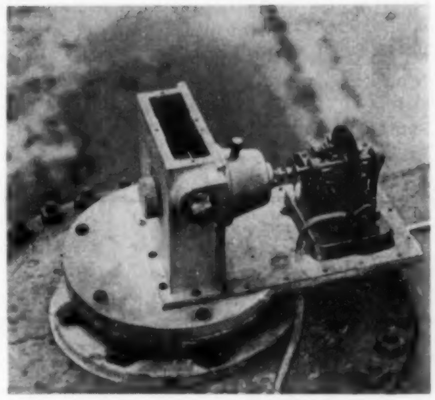
Side View of Top-Feed Filter

Depending on the material to be handled, the top-feed filter is claimed by the manufacturers to be capable of drying to ½ per cent of moisture or even less. Some of the materials for which it is said to be suitable include: flake and vacuum pan salt, bicarbonate of soda, tri-sodium phosphate, ammonium sulphate and similar crystalline materials, as well as such fibrous products as cotton, linters, cottonseed meal, and other vegetable materials of like nature. Sizes in which the new filter is available are suited to the requirements. The machine shown in the accompanying view is 6 ft. in diameter and has a 1-ft. face.

Fluid Level Indicator

REMOTE indication of fluid level is accomplished by means of a new type of transmitting and indicating mechanism recently developed by J. H. Bunnell & Company, 215 Fulton St., New York City, and marketed under the name of the MacCreedy fluid level indicator. This device is of the step-by-step type, giving indications in feet, inches, and eighths of an inch for any depths of tank. The transmitting mechanism shown in an accompanying halftone comprises two parts, the float and the transmitter proper. The float consists of two guided bodies which ride on the surface of the tank contents, and are counterbalanced by means of a weight moving in an oil-tight pipe or tube. This weight is connected to the float by means of a perforated tape. The float is so weighted that change in specific gravity has only a small effect on the indicator reading.

The perforated tape travels over a toothed drum, and in its movement causes rotation of a gear wheel which operates the contacts. The latter are of the inclosed mercury type. One contactor operates for rising liquid level and the other for falling liquid level. For each change of ⅛ in. in level, a separate impulse is sent to the receiving indicator. The indicator contains two solenoids which operate a ratchet. As the liquid level rises, one set of transmitter contacts functions continuously, each impulse turning the indicator in the direction of greater liquid level. The reverse is true for falling level. The indicator has two hands, one of which indicates feet and the other inches and eighths of an inch.



Cover Removed From Transmitting Mechanism of MacCreedy Level Gage

The system is operated with batteries to insure continuity of operation. The apparatus is made of corrosion-resisting metals and has no open contacts which might corrode or might ignite combustible gases. The transmitter is hermetically sealed to insure long life. The standard instrument is capable of transmitting to a number of indicators over any distance up to 4 miles. Distances greater than 4 miles may be handled by special means. The device may also be installed, using methods developed by the company, on the roofs of the floating and breather type.

Self-Contained Variable-Speed Drive

COMBINING a modification of its standard "JFS" variable-speed transmission with a standard motor, Stephens Adamson Manufacturing Company, Aurora, Ill., has developed and

New Combination Motor and Variable-Speed Drive

announced a new self-contained variable-speed drive made in sizes from $\frac{1}{2}$ to $7\frac{1}{2}$ hp. The "JFS" drive was originally described in the October, 1927, issue of *Chem. & Met.* Briefly it consists of two specially shaped, divided races between which rotate three double-conical rollers. The input speed is transmitted directly to the inner race, the halves of which are forced together by spring pressure. Its rotation communicates planetary motion to the rollers, which are in contact with the stationary outer race. A cage on which the rollers are mounted delivers the output speed. By adjusting the distance between the halves of the outer race, the effective diameters of the races and rollers are altered and the speed is changed.

In the new modification, a single housing incloses both transmission and motor. The motor shaft is extended to form the high-speed shaft of the transmission. A handwheel permits adjustment of the speed of output between 24 and 144 r.p.m. or 120 and 720 r.p.m. The motor speed is 1,200 r.p.m.

By combining the motor and transmission, the manufacturer states that 25 per cent of total length and weight has been saved. Transmission is said to be positive within the rating of the machine. Additional advantages include easier installation, speed reduction without vibration, long life, and elimination of danger of contact with moving parts.

Photo-electric Relay

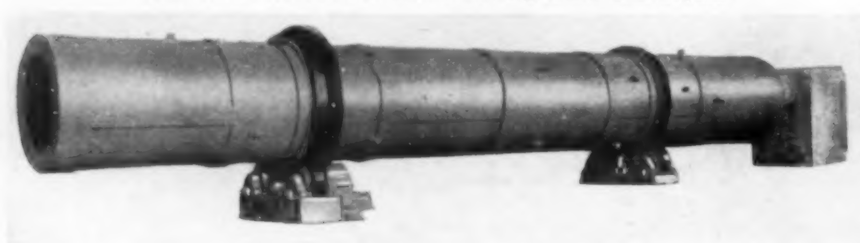
COMPACTNESS is a feature of a new photo-electric relay and light source which has been developed by the G-M Laboratories, Inc., Grace and Ravenswood Aves., Chicago, Ill. The instrument consists of a single casing, containing in the upper part a light source and in the lower part, the photo-electric cell. Light from the source passes through a lens, is reflected from a remotely placed mirror, and is received by the photo-electric cell. Any interruption of this beam of light, then, operates the relay contacts to actuate mechanism such as counters, power switches, signals, or other devices. The instrument operates from an ordinary 110-volt, 60-cycle line.

Roller-Bearing Dryers

ROTARY DRYERS and kilns in sizes ranging from $2\frac{1}{2}$ to 10 ft. in diameter, and in length from 20 to 200 ft. or more, have recently been announced by the Struthers-Wells Company, Warren, Pa. They are suitable for pulverized-coal, gas, or oil firing; are supplied in either riveted or welded construction; and are either fully or partially lined with refractory brick. Partial linings permit drying and calcining within the same shell.

Weight of the shell is carried on two tires mounted so that expansion of the shell will not affect their proper register with the trunnion rollers. The latter are provided with Timken roller bearings. The pedestals supporting the shafts of the rollers are adjustable in four directions to compensate for inaccuracies of leveling during installation. Use of anti-friction bearings has, according to the manufacturer, made minimum power consumption possible.

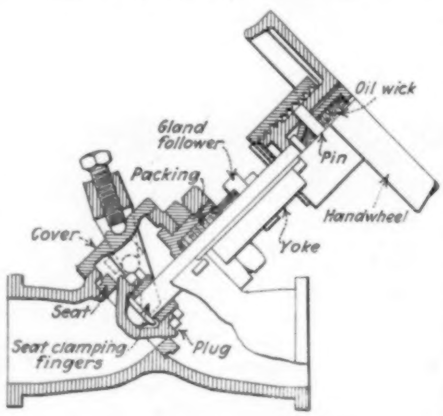
One of a New Line of Roller-Bearing Kilns and Dryers



Acid-Proof Valve

FOR USE with a wide variety of corrosive fluids, including many acids and most of the alkalis, the LaBour Company, Elkhart, Ind., has developed and placed on the market a new line of valves made of Elcomet K. The valves are available in sizes ranging from 1 to 4 in. and in both the throttling and check styles.

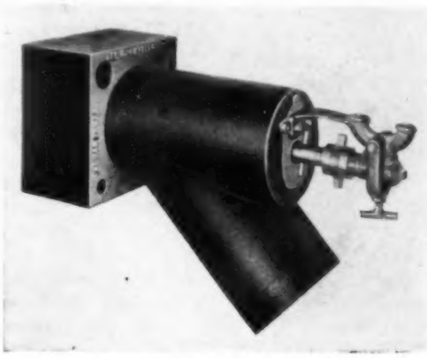
An accompanying drawing illustrates



Cross-Section of New Acid Valve

the throttling model. It will be observed that the construction is of the straight-away type with the stem set at 45 deg. to the flow. All principal parts of the valve, with the exception of the handwheel and oil reservoir, are made of Elcomet. Other special alloys may be supplied, however, if necessary. A principal feature of the valve is the removable cover plate, which is secured to the body by means of a one-screw clamp. The cover plate carries fingers which, when it is clamped in place, securely anchor the removable seat. This construction makes for ready inspection or removal of both the seat and the full-floating plug. Another feature is the method of protecting the operating mechanism from creeping acid. The stem is of the lifting type but does not turn. The operating threads, it will be observed, are fully covered and are lubricated from a wick-filled oil reservoir in the handwheel.

The new check valve makes use of the same body, substituting a cover plate for the bonnet and yoke. The valve disk is hinged to the seat, which is held in place as described above.



Burner Assembly for Combination Fuel

Combination Fuel Burner

VERSATILITY is a feature of a new high-pressure, water-cooled burner, which has been developed by Lee B. Mettler Company, 406 South Main St., Los Angeles, Calif., for burning gas, oil, or pulverized coal, separately or in combination. The burner proper is made of heat- and corrosion-resisting material and is arranged for water-cooling. Gas is supplied to the burner through a single inlet pipe and is delivered from a number of orifices placed around the circumference of an annular gas chamber. Combustion air is forced through the center of the burner at high velocity, entraining the gas and assuring, according to the manufacturer, high combustion efficiency. If other fuels are to be used, they are likewise injected through the center of the burner.

The burner is available in three sizes, for 8-, 6-, and 3-in. pressure-air or pulverized-fuel connections. The gas inlets are 2, $1\frac{1}{2}$, and 1 in., while the water connections are 1, $\frac{3}{4}$, and $\frac{1}{2}$ in., respectively.

Recording Color Analyzer

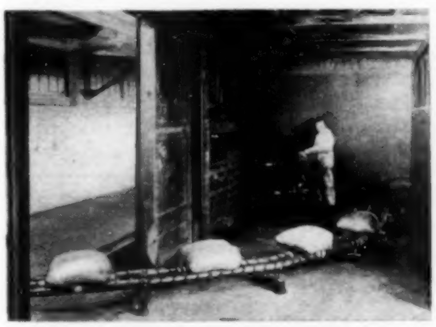
IT HAS BEEN announced by the General Electric Company, Schenectady, N. Y., that a commercial model of its recording color analyzer (early work on which was described in *Chem. & Met.* on page 765 of the December, 1928, issue) has been put on the market. The new instrument is considerably more compact and sturdy than the earlier laboratory model described in the reference. It is a photo-electric device which automatically draws a curve of the color

analysis of the sample in the visible spectrum. Either solid substances or transparent materials can be analyzed.

Operation of the instrument is briefly as follows: Light from a vertical tungsten-ribbon filament passes into the slit of a dispersive system, from which it emerges as monochromatic light. It is split and half is used to illuminate the sample, and half, a flicker disk, the surface of which is coated with a standard white pigment. As the flicker disk revolves, the reflection falling on a photo-electric tube is alternately that from the disk (standard), and from the sample. If these reflections are not equal, the resulting pulsating photo-electric current, which is amplified electrically, operates a motor-operated shutter in the standard light path, throttling it until the reflections are equal in magnitude. The balance point is indicated by the recorder.

As the record drum revolves, the wave length of the light given off by the dispersive system is varied at a uniform rate from 400 to 700 millimicrons. At each wave length, the curve obtained indicates the position of the shutter and hence the intensity of color of the sample for each wave length.

As was pointed out in the original article, this instrument has a field of application in all industries depending on color, including the manufacture of oils, dyes, paints, pigments, inks, and paper. It operates from the ordinary plant power supply but requires in addition an 8-volt storage battery. A specially trained operator is not required.



TwinVeyor Loader in Operation in a Freight Car

Car Loading Conveyor

IN ITS June, 1930, issue, *Chem. & Met.* described the recently developed Clark TwinVeyor made by the Clark Tructractor Company, Battle Creek, Mich. In a modification of this device, recently announced, eight short sections are added to the end of a standard TwinVeyor to permit making a right-angle turn into the car. How this is accomplished its shown in the accompanying illustration. As the car is filled, the conveyor is successively shortened until one end has been completely loaded. The operation is then repeated at the other end. Transposing the right- and left-hand tubes in the assembly reverses the flow of material and makes it possible to unload cars in a similar manner.

Explosion-Proof Starter

UNDERWRITERS' Laboratories have approved for Class I, Group D, hazardous locations a new explosion-proof starter which has been put on the market by the Louis Allis Company, Milwaukee, Wis. This starter is of the air-contact, broad-flange type, and is built to withstand any explosion which may be initiated within the case, without permitting flames to escape from the cast-iron body of the apparatus. As a result of this construction, the starter is said to be suitable for use in places where gasoline, naphtha, benzol, toluene, ethyl acetate, alcohol, and other solvent materials are made, used, or handled. The manufacturer's designation on this equipment is Type E, Form AAA.

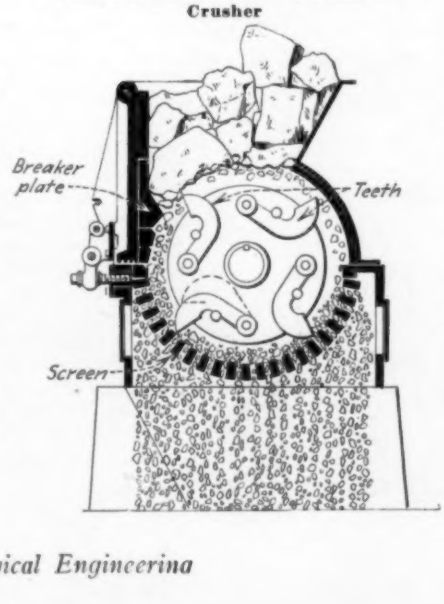
Novel Crushing Mill

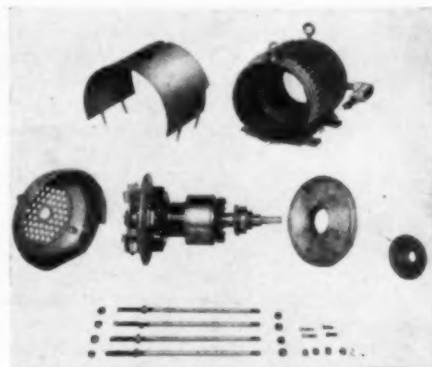
A NEW slow-speed crusher for reducing coal and materials of similar crushing characteristics to uniform small size has recently been announced by the Jeffrey Manufacturing Company, Columbus, Ohio. This is a modified hammer mill in which the hammers or teeth are mounted around the periphery of a drum consisting of parallel, circular spacing plates mounted on the crusher shaft. An accompanying drawing shows the teeth to be of special shape, whereby they are held in operating position by centrifugal force but are readily pushed back into the drum by contact with tramp iron or other materials which might injure the crusher.

Features of the mill include renewable steel crusher teeth, heavy, rugged construction, a hinged breaker plate allowing easy access to all working parts, and a large screening area which is said to assure high capacity of uniform output. Mills are obtainable in sizes for handling lumps up to 24 in. and producing up to 350 tons per hour of 2-in. product, or 90 tons per hour of $\frac{1}{4}$-in. product.

The Jeffrey company also has announced a new line of chains and buckets. These are made of a special, recently developed grade of malleable iron known as "Supermal." This alloy is said to embody greater resistance to wear, higher tensile strength, and higher elastic limit than malleable products heretofore available. The yield point and hardness of the new material are reported to be slightly higher than in 12-per cent manganese steel and the tensile strength 15,000 lb. higher than ordinary malleable iron. These characteristics are said to be obtained without brittleness.

Cross-Section of New "Flextooth" Crusher





Major Parts of New Totally Inclosed Motor

Totally Inclosed Motor

WELDED STEEL construction, anti-friction bearings and fan-cooling have been incorporated in a new totally inclosed induction motor made by the Lincoln Electric Company, Cleveland, Ohio. The motor has the same mounting dimensions as standard, open-type horizontal motors of equal rating and is available in sizes from 1 to 50 hp. The outer casing is provided with deep corrugations, against which the heated air within the motor is forced by a fan. A second fan placed outside the closure, but within a protective housing, forces fresh air constantly over the corrugations. A removable sheet metal covering is applied over the latter in order to form the air channels. Details of the motor are shown above.

Electric Coal Feeder

MECHANICAL firing of lime kilns is the object of an improved, electrically driven coal feeder recently announced by Arnold & Weigel, Woodville, Ohio. The "Ward" feeder consists essentially of an endless metal conveyor which feeds coal from an overhead hopper at a predetermined rate into a small chamber below the conveyor. At intervals determined by the timing apparatus, which is part of the feeder, the bottom of the chamber opens and discharges the contents into the kiln below.

In order to provide for distribution of the coal within the kiln, a deflecting plate placed beneath the coal-collecting chamber is operated by the same timing mechanism that controls the feeding mechanism proper. In a typical cycle, on the first discharge the deflector is

toward the left and the entire charge is dropped on the left side of the fire bed. On the next discharge the deflector is vertical and the charge drops to the center of the bed; and on the third cycle, discharge is toward the right side of the bed. The entire mechanism is operated by a $\frac{1}{2}$-hp. a.c. motor, and the various adjustments provided make possible the feeding of coal at any rate within the capacity of the machine.

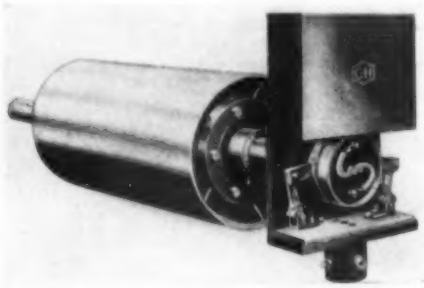
Improved Hoisting Apparatus

TWO IMPROVEMENTS in hoisting equipment have recently been announced by Chisholm-Moore Hoist Corporation, North Tonawanda, N. Y. The new "Cyclone" twin-hook electric chain hoist is intended for handling bulky loads requiring support at two points from 3 to 15 ft. apart. Capacities for the hoists of this line range from $\frac{1}{2}$ to 3 tons. The mechanism is supplied with anti-friction bearings, a single-speed drum type controller operated by a pendant rope, safety limit stops, and a magnetic brake.

The second development is a new wire-rope electric hoist for operating under conditions of extremely low headroom. This is known as the "Hi-Up" hoist and is available for either stationary or trolley mounting. Push-button control is standard. The equipment operates on anti-friction bearings and is provided with a magnetic brake.

Magnetic Separator Pulley

SIMPLE CONSTRUCTION, long-wearing qualities, and lower price are said to be features of the new Type W magnetic separator pulley which has been announced by Cutler-Hammer, Inc., 91 Twelfth St., Milwaukee, Wis. The new pulley consists of a machined



New Type W Magnetic Separator

cast-steel spool, the magnet coils and a coil shield, and the necessary insulation. The coils are wound on the steel spool and impregnated so as to be moisture-proof. The coil shield is welded to the spool to make a permanent closure. The latter is of chrome-nickel steel and is non-magnetic.

The commutating mechanism consists of heavy brass collector rings and carbon brushes and is provided with a dust-proof cover. Pulleys are available in six lengths for belt widths varying from 12 to 30 in. Standard diameter is 12 in.

Left, Jacketed Mixer

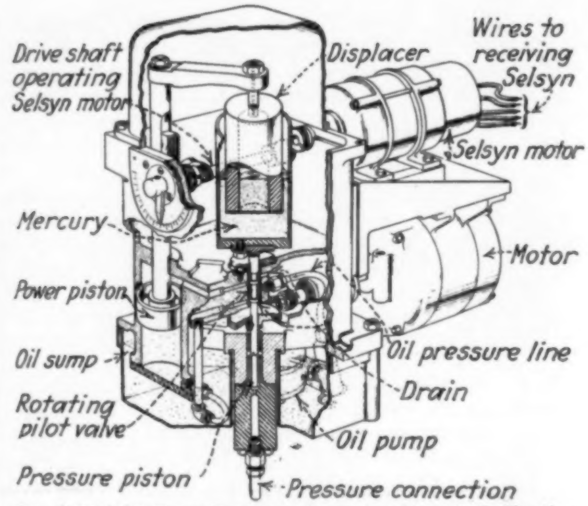
Turbine-Type Mixer

BLAW-KNOX Company, Pittsburgh, Pa., has recently announced a new turbine-type mixer which consists of one or more turbines revolving on a shaft centrally located in the mixing vessel. The turbines are of all-welded construction, consisting of an upper and lower containing ring with straight blades welded in place. Surrounding each turbine are stationary blades for radially deflecting the flow of liquid. Materials to be mixed are drawn into the turbines at the center and discharged radially through the stationary blades. The result is to deflect currents upward and downward, causing material to pass repeatedly through the turbines.

It is pointed out by the manufacturer that the turbine mixer causes the increments of liquid to change both horizontal and vertical positions, while it also eliminates swirl, produces uniform stream lines throughout the entire mixture, and yields a thorough breaking up and distribution of the increments. Power consumption is said to be low. The company is prepared to supply the new mixer made of any suitable material and in shapes and sizes dictated by the needs of the user.

Remote-Indicating Pressure Gage

PRESSURE measurements of accuracy equal to those of the dead-weight gage tester, together with permanent calibration and unlimited power for the operation of indicators, recorders, and control devices, are said to be possible with the new power-type pressure gage announced by the Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio. The drawing illustrates the principle of this device. The pressure to be indicated or recorded is applied to a small pressure piston which supports a pilot valve and a cup containing mercury. This portion of the gage is continuously rotated to eliminate static



Dead-Weight Type Pressure Gage for Remote Indication

friction. The motor which rotates the system also operates a small oil pump to provide oil pressure for operation of the power piston, displacer, and Selsyn motor.

When the applied pressure increases or decreases, the pressure piston rises or falls proportionately, and in so doing permits oil under pressure to pass through the pilot valve to the upper or lower side of the power piston. If the pressure is increasing, the pressure piston, pilot valve, and mercury cup rise, thus supplying oil pressure to the upper side of the power piston. This lowers the displacer deeper into the mercury, tending to force the mercury cup and pilot valve downward, and to return the pilot valve to its neutral position and so close off the oil supply to the power piston. Consequently, for each pressure against the pressure piston, a definite position of the power piston and displacer is obtained. A Selsyn motor driven from the rack on the power piston shaft also assumes a definite position for each pressure. One or more receiving Selsyns follow the motion of the transmitter and hence give accurate indications of the pressure at one or more indicators, recorders, or controllers.

According to the manufacturer, an important feature of this instrument is its ability to give a high minimum pressure and a short total range. Varying the relative sizes of the pressure piston, mercury cup, and displacer permits the design of the device for practically any maximum pressure. For example, it may be calibrated for such a range as 385 to 415 lb. The indicators supplied are 42 in. in diameter, a factor which makes accurate reading possible.

Close-Coupled Pump

HORIZONTAL centrifugal pumps of the close-coupled type, in which the pump and motor are mounted together in unit construction, have been announced by the Chicago Pump Company, 2336 Wolfram St., Chicago, Ill. The new line is given the designation "N-Type." It includes pumps of $1\frac{1}{4}$- and $1\frac{1}{2}$-in. suction and 1-in. and $1\frac{1}{4}$-in. dis

charge. Capacities range upward to 60 g.p.m. at 56-ft. head. The pumps are heavily constructed and are capable of withstanding a suction pressure of 200 lb.

Construction of the pump is said to insure long life. The impeller is of bronze, the motor shaft of stainless alloy steel, and the pump casing of semi-steel. The stuffing box is extra deep and the gland is split to make repacking easy. The pumps are obtainable either with or without a water seal. The pump is supported at three points to make installation easy.

Constant-Weight Feeder

A NEW MODEL of the constant weight feeder made by the Hardinge Company, York, Pa., originally described on page 181 of the March, 1930, issue of *Chem. & Met.*, has recently been announced. This is known as Type D. It is a heavy-duty machine, built very much stronger than the standard types previously available. It is supplied in capacities ranging from 10 to 1,000 tons per hour to handle material ranging from very fine powder to lumps as great as 5 in. in diameter.

In the original announcement the feeder was shown to consist of a conveyor, balanced like a scale beam, which weighed the load on the conveyor and adjusted a gate to control the flow of material from a feed hopper. The new model is identical in principle, although its construction is sturdier and it has been provided with additional idlers for supporting the conveyor belt. It may be equipped with a remote-control attachment which has been developed by the company, and with a no-load cut-off device which instantly stops the machine and signals the operator when the feed is interrupted.

CO_2 Indicator and Recorder

REDESIGN of the Ranarex CO_2 indicator and recorder has been announced by the Permutit Company, 440 Fourth Ave., New York. The parts of this machine are shown in an accompanying view. The center portion is a casing containing space at the top for the driving motor, and below are two cylindrical compartments in which the fans operate. As appears in the illustration, the motor is mounted on a panel and drives a pair of fans at constant speed. When the recorder is assembled, the fans set up a whirl of gas in the two cylindrical compartments. Two additional fans, attached to a panel carrying the indicating and disk-chart recording mechanism, are caused to rotate by the whirling columns of gas through an angle proportional to the density of the gas. Gas to be analyzed is passed continuously through one compartment and a reference gas, usually air, through the other compartment. Thus the relative movement of the two fans, which are connected by a linkage, is a measure of the difference in density between the gas and the air and hence, of the percentage of CO_2.

These machines also are available for the determination of composition of other gases as well as for the indicating and recording of specific gravity. Special scales in any desired range are available from the manufacturer.

Grindability Machine

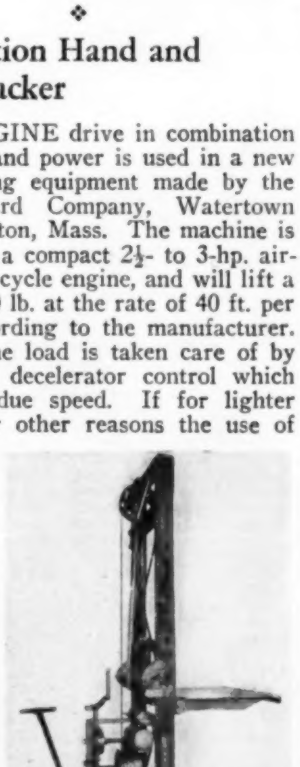
FOR COMPARING the relative ease of grinding of various materials, the Whiting Corporation, Harvey, Ill., has developed what is referred to as a "Grindability Machine." The machine is of the mortar and pestle type and in a constant number of strokes pulverizes a constant weight of the material on trial. The product is then passed through a screening machine and each size is weighed and multiplied by a coefficient. The sum of these figures is compared with a standard result, and expressed in terms of per cent "grindability."

Combination Hand and Power Stacker

GAS-ENGINE drive in combination with hand power is used in a new line of lifting equipment made by the Lewis-Shepard Company, Watertown Station, Boston, Mass. The machine is operated by a compact 2½- to 3-hp. air-cooled, four-cycle engine, and will lift a load of 1,000 lb. at the rate of 40 ft. per minute, according to the manufacturer. Lowering the load is taken care of by means of a decelerator control which prevents undue speed. If for lighter loads or for other reasons the use of hand power becomes desirable, the motor need not be operated. It is pointed out that such equipment obviates the necessity for having electric power readily available.

Disassembled View of New Ranarex CO_2 Recorder

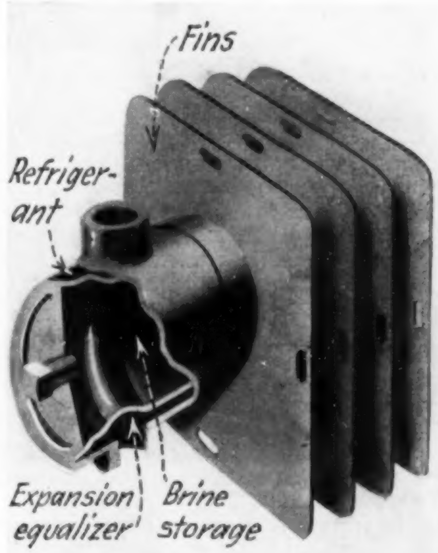
New Power Hand Stacker



Refrigeration Grids

LARGE heat transfer capacity is said to be embodied in a new design of refrigeration unit, known as the "Hydro-Thermal Grid," which is being manufactured by the American Engineering Company, 2668 Cumberland St., Philadelphia, Pa. The units are intended for assembly in groups to provide any desired capacity, and are to be used in place of coils in mechanical refrigerating systems.

Construction is shown in an accompanying illustration to consist of an



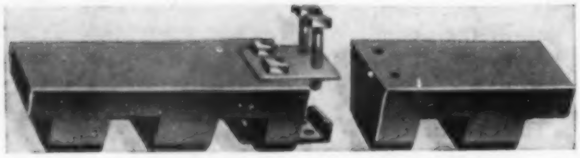
Cut-away View Showing Construction of Refrigeration Grid

outer tube with fins, inclosing an inner tube and thus providing a large heat absorbing area in a very small space by spreading the refrigerant in a thin layer over a large area of the outer tube. Refrigerant enters at one end of the tube and the resulting gases escape at the other. When a hold-over is desired, the inner tube can be filled with brine.

Both tubes and fins are made of steel, eliminating any possibility of electrolytic action. Close frictional contact between the fins and the tube and galvanizing of the exterior secure a perfect bond between the metals, according to the manufacturer. The grids are supplied with fins in three sizes, and in a number of lengths.

Link-Wedge Belt

MANUFACTURING and distributing rights in North, South, and Central America for the Link-Wedge V-belt, recently developed in Germany, have been acquired by the Dayton Rubber Mfg. Company, Dayton, Ohio. An accompanying illustration shows the construction of the new belt. It con-



Section of Link-Wedge Belt With Clamp for Ends

sists of rubber and fabric with integral cogs on the inside. It is adapted to run on a standard V-shaped pulley. The belts are made in large sheets and can be cut to the desired width and length. On this account, it is said to be possible to make a belt of any necessary length at minimum cost. The illustration also shows the metal clamp which is used to join the ends. The Dayton company intends to use the new belt to augment its present line of endless V-belts.

Heavy-Duty Pressure Gage

HIGH PRESSURES and high temperatures now in use are responsible for the development of the new Ashcroft American Duragage, which has been announced by Consolidated Ashcroft Hancock Company, Bridgeport, Conn. The movement in the new gage is made of Nitralloy steel and the bourdon spring is bored out of special solid steel alloy which is said to have absolutely uniform expansion and contraction throughout the entire range of the instrument. The resulting gage has uniform dial graduations and has a guaranteed accuracy of 0.5 per cent. The instrument is unconditionally guaranteed for five years.

Important features include the use of a pointer which has an integral micrometer adjustment; sockets which are made of forged steel; and casings which are die cast and finished in a corrosion-proof manner.

Improved Hoists

TWO RECENT improvements in hoisting equipment have been announced by the Shepard Niles Crane & Hoist Corporation, Montour Falls, N. Y. The new "Compact Hoist" shown in an accompanying view, is provided with an improved electric brake and limit switch, with ball-bearing trolley wheels, with cooling fins cast integral with the gear end-section inclosure, and with a balanced drive through the use of planetary gearing. The second improvement relates to the Model 21 trolley, which has been developed to propel light capacity hoists along their runways. This is of all-steel construction, equipped for grease lubrication. Trolleys are equipped with ball bearings throughout. They are adapted to the propelling of hoists such as that shown in the illustration.

Improved "Compact Hoist"

Manufacturers' Latest Publications

Blowers. Stacey Engineering Co., Connersville, Ind.—Bulletin 21-B10—New bulletin on "Victor-Acme" rotary positive blowers, issued by the Roots-Connersville-Wilbraham Division of this company. Also new price list on these machines.

Chemicals. Glyco Products Co., Bush Terminal Bldg. 5, Brooklyn, N. Y.—Leaflets describing various products offered by this company, including waxes, emulsifying agents, adhesives, resinous materials, and other organic products for special purposes.

Control. Atlas Valve Co., 282 South St., Newark, N. J.—12 pages describing damper regulators for boilers in the low-, medium-, and high-pressure classes.

Control. Bristol Co., Waterbury, Conn.—Catalog 2002—20 pages on motor-operated valves for the automatic control of temperature. Also briefly describes recorders and equipment for controlling temperatures, pressures and levels.

Control. Esterline-Angus Co., Indianapolis, Ind.—Folder 231—Describes the use of recording ammeters in controlling the relative speeds of the calender and dryer motors in a paper machine.

Disintegration. Raymond Bros. Impact Pulverizer Co., 1302 North Branch St., Chicago, Ill.—8-page illustrated pamphlet describing installations of this company's pulverizing, drying, and air-separation equipment made in process and power plants during 1930.

Disintegration. Smith Engineering Works, East Capitol Drive and Holton St., Milwaukee, Wis.—Bulletin 263—11-page illustrated booklet describing at length and giving specifications on this company's new Telsmith cone crusher.

Electrical Equipment. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Bulletin 41—12-page pamphlet on stationary, oscillating, ceiling, and ventilating electric fans. Also bulletins of the Roth Bros. & Co. Division of this company, describing inverted rotary converters and an emergency lighting system.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-214B, helicoil sheath-wire immersion heaters; GEA-1262A, "thrustors," electrically operated hydraulic thrust producing mechanisms; GEA-1275, fractional horsepower motors, d.c.; GEA-1352, squirrel-cage induction motors; GEA-1363, Form IG resistor units; GEA-1368, vertical hollow-shaft induction motors; GEA-1379, electrical heating equipment for lehrs; GES-686, folder outlining types of direct-current motors.

Electrical Equipment. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 168—Describes a number of new electric fans; a second publication, Bulletin 169, describes a slip-ring motor.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—"Engineering Achievements of the Westinghouse Electric & Mfg. Company During 1930," a 40-page book summarizing and describing the more important developments made by this company during the year, mostly in electrical equipment.

Filtration. Oliver United Filters, Inc., 33 West 42d St., New York City—Bulletin 203—30-page booklet fully describing the line of vacuum filters made by this company, including the new top-feed filter and the Oliver-Borden thickener.

H_2SO_4 Recovery. National Lead Co., 111 Broadway, New York City—Bulletin 5—27 pages of description and engineering data on the Simonson-Mantius vacuum process for the recovery and concentration of sulphuric acid.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Folder briefly describing the advantages of steam metering; also Catalog 3004, 32 pages on the principles and applications of electric carbon-dioxide meters.

Lubrication. Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.—Folder briefly describing two types of driving mechanism for mechanical lubricators.

Materials Handling. Fuller Lehigh Co., Fullerton, Pa.—Bulletin 903—8-page bulletin fully describing the use of the Fuller-Kinyon transport system for the handling of pulverized coal.

Metals and Alloys. Climax Molybdenum Co., 295 Madison Ave., New York—22-page pamphlet illustrated with charts, curves and photomicrographs, concerning the effects of molybdenum as an ingredient of cast iron.

Power Generation. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin S-500-B5—8 pages on vertical, 4-cycle, direct-injection Diesel engines, 50 to 150 hp.

Power Transmission. W. A. Jones Foundry & Machine Co., 4401 Roosevelt Road, Chicago, Ill.—Bulletin 49—Description and ratings of worm gear reducers made by this company; 8 pages.

Pumps. Duriron Company, Dayton, Ohio—Bulletin 164—Information and performance curves on two Duriron centrifugal pumps for acid service, one a standard pump and one self-priming.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Specification Sheet W-112-S6, horizontal duplex-piston pumps; Specification Sheet W-112-S9, horizontal, duplex-piston, hot oil pumps; Specification Sheet D-423-S9, vertical, triplex, single-acting power pumps.

Refractories. Ironton Fire Brick Co., Ironton, Ohio—Leaflets describing the "Standard," "Steel," and "Peerless" refractories made by this company. Each leaflet lists chemical and physical properties and gives the field of application.

Regulators. Natural Gas Equipment, Inc., Petroleum Securities Bldg., Los Angeles, Calif.—Catalog 101—Handsomely illustrated 60-page book on gas regulators, pump and compressor governors, motor valves, vacuum and differential regulators, balanced lever valves, liquid level controllers, and engineering services offered by this company.

Screening. Hendrick Mfg. Co., Carbondale, Pa.—12-page folder including specifications and description of perforated plates for vibrating screens.

Steam Generation. Boiler Engineering Co., 24 Commerce St., Newark, N. J.—6-page folder describing Beco-Turner baffle walls for boiler furnaces.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York.—Catalog GC-6—16 pages on steam generators, stokers, fuel pulverizers, and other steam-generation equipment.

Steam Purification. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin No. 9-P—8 pages on steam purifiers and oil separators for use on power and process steam.

Testing and Research. Pittsburgh Testing Laboratory, Pittsburgh, Pa.—Well-illustrated 32-page book describing chemical, metallurgical, and physical laboratory facilities; and testing, inspection, and research activities of this company.

Tubing. Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Form 522-2—56-page book giving engineering and operating data on Nirosta KA2 seamless tubes and pipes. Lists corrosion data for a very large number of corrosive materials.

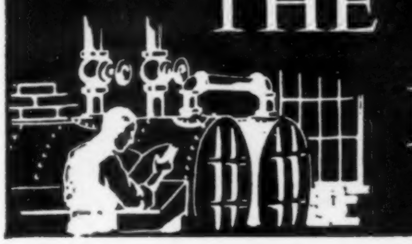
Weighing. Sintering Machinery Corp., 75 West St., New York.—18-page bulletin describing the "Transportometer," a continuous weighing device for integrating the weight of bulk materials passed over a conveyor belt.

Welding. Alloy Welding Process, Ltd., Ferry Lane Works, Forest Road, London, E-17, England. 16-page booklet on the application of welding in the fabrication of equipment used in the chemical industry. Deals with the subject from the standpoint of the materials used for equipment, rather than specific equipment types.

Welding. Lincoln Electric Co., Cleveland, Ohio—Section 3304—20 pages on arc-welding supplies, including electrodes, cable, clothing, publications, and other miscellaneous welding necessities.

Welding. Lukenweld, Inc., Coatesville, Pa.—20-page booklet describing the application of welding by the "Lukenweld Process" in the fabrication of heavy equipment.

THE PLANT NOTEBOOK



How to Use Thermocouples in Humidity Determination

By Paul E. Demmler
Material and Process Engineering Department
Westinghouse Electric & Mfg. Company
East Pittsburgh, Pa.

Determining the relative humidity of the atmosphere by the use of wet- and dry-bulb thermometers is a well-known procedure. A sling psychrometer in which a wet-bulb and a dry-bulb thermometer are whirled for 15 or 20 seconds, after which the temperatures are read, usually is considered to be the standard instrument for determining relative humidity, but other forms of hygrometers may be used if the velocity of the air passing the bulbs of the thermometers is at least 3 meters per second. Regular commercial recording thermometers may be used and there are instruments on the market which are provided with motor and blower for producing the flow of air necessary to get a satisfactory record of the wet-bulb temperature.

Instruments of the types mentioned above are very convenient when the relative humidity of a room, or other readily accessible space, is to be determined; but there may be occasions when we wish to determine the relative humidity of air flowing through a pipe, or passing some point where the ordinary types of instruments cannot be used. In cases of this kind, the temperatures must be indicated at a distance from the point being studied, and thermocouples furnish a very convenient means of making the determination.

Laboratory tests were made to find the conditions under which thermocouples would give satisfactory results when used for determining relative humidity. Two-conductor thermocouple cable containing copper and Advance (copper-nickel alloy) wires was used for making the couples, and a potentiometer temperature indicator, with calibration curve to convert millivolts to degrees, was used for making the temperature measurements.

Results comparable with those obtained by the use of other types of hygrometers may be obtained with wet and dry thermocouples if the following precautions, relating especially to the wet thermocouple, are observed:

The junction of the thermocouple wires should be about 1 in. beyond the end of the covering of the cable, and the bare wires should be completely inclosed in the wet fabric. When bare wire is exposed above the wet fabric, the temperature indicated by the wet thermocouple may be too high, due probably to the high heat conductivity of the metals. The fabric used must be such that the part around the couple will be kept thoroughly wet while the test is being made. If water is not drawn up rapidly enough, the fabric will dry out partially and the temperature indicated will be too high. Velocity of the air current passing the thermocouples should be at least 3 meters per second, just as in the case of wet- and dry-bulb thermometers.

Using thermocouples in the way described above furnishes a convenient method for determining the relative humidity of the atmosphere in inclosed spaces where there is circulation of the air, but where it would be difficult or impossible to use other types of hygrometers. By using a potentiometer as the indicating instrument, thermocouples of any desired length may be used, and the potentiometer may be placed at any desired distance from the point where the humidity is to be determined.

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Technique in Soldering "18-8" Steel Alloys

By Kenneth T. MacGill
Joseph T. Ryerson & Son, Inc.
Chicago, Ill.

With the advent of the "18-8" chrome-nickel-iron alloys as important commodities in industry, the problem of soldering has been given much consideration. To those who have attempted it for the first time the process might seem unusually difficult. As a matter of fact they can be soldered easily and well. Soldered joints have shown as high as 8,000 lb. per square inch on tensile pull tests.

A knowledge of the physical properties of both the alloys and the solder is a help in overcoming any difficulty that may be met. Certain of the properties which make such materials so desirable to use, such as resistance to chemical action and low ratio of thermal conductivity (they are only about 72 per cent iron), are directly opposed to the properties which make ordinary soldering easy.

The strength of a soldered joint is built up to a large extent by the fillet which should be formed on the back of the seam as well as the front where the soldering iron is in contact with the metal. To secure such full penetration it is necessary, of course, that the full width of the seam be heated to a point above the complete liquidation point of the solder. Appreciating the slowness with which these alloys conduct heat, it is obvious that in soldering, using ordinary grades of solder, either greater heat must be used on the soldering iron or the travel of the iron must be slower, so as to give sufficient time for the full width of the seam to attain the proper temperature.

Both of these methods are objectionable in that they make the operator deviate from his usual practice. To overcome this we have developed special solders for both chemical and dairy uses of these alloys. These not only have greater strength than the ordinary solder but are completely liquid at lower temperatures. The temperatures used in ordinary soldering heat the entire width of the seam to a point where these new solders will penetrate the seam and form the necessary fillet on the back.

In order to obtain these results, the parts to be soldered must, of course be free from oxide and grease. To etch these highly resistant materials properly, a special flux has been developed. Because of its continued action it is necessary for the workman, when the job is completed, to wash all surfaces thoroughly with an alkaline solution.

Tests have shown that a soldered joint with $\frac{1}{64}$ in. of solder between the surfaces has much greater strength than a job where the surfaces are only sweated together. It is evident that if the two surfaces to be soldered are tightly clamped together, neither the flux nor the solder can penetrate. Care should be taken, if the two pieces must be clamped in order to hold them, that a thin spacer or a slight crimp is put in the metal at the point where the clamp is placed, in order to insure sufficient space for both the flux and solder to penetrate.

A Reminder—

The Editors are always glad to receive short articles on plant or operating kinks and shortcuts for use in this department. Your article need not be elaborate. Compensation starts at $5.

NEWS *of the* INDUSTRY

Prominent Speakers for A. C. S. Meeting

AMONG the prominent features which have been arranged for the eighty-first meeting of the American Chemical Society, to be held at Indianapolis, March 30 to April 3, are a symposium on combustion and an extensive review of the progress made in the field of petroleum chemistry. Dr. G. St. J. Perrott, of the A. O. Smith Corporation, will be in charge of the symposium.

A report of a microscopical and X-ray study of Pennsylvania anthracite will be made by Homer G. Turner, director of research for the Anthracite Institute, and H. V. Anderson, associate professor of chemistry in Lehigh University. Other speakers will include: Prof. S. W. Parr, University of Illinois; E. B. Kester, E. J. Schneider, G. W. Jones, and Bernard Lewis, U. S. Bureau of Mines, Pittsburgh, Pa.; C. R. Holmes; N. D. Pohle; Henry Seaman; Dr. S. P. Burke, University of West Virginia; T. E. W. Schumann; H. R. Mathias; Prof. E. J. Demorest, Ohio State University.

Chemists from the research laboratories of oil and motor companies, federal bureaus, and the universities will report advances in the field of petroleum chemistry, according to an announcement by Dr. Cary R. Wagner, chief chemist of the Pure Oil Company, Chicago, chairman of the Petroleum Division.

Production of motor fuels from natural gas will be the theme of a paper to be presented before the division by H. M. Smith, Peter Grondona, and H. T. Rall, of the U. S. Bureau of Mines, Bartlesville, Okla.

Photographic flame studies will be reported by Lloyd Withrow and T. A. Boyd, of the General Motors Research Laboratories, Detroit.

August Holmes, of the technical service division of the Standard Oil Company of New Jersey, will discuss "The Carbureting Values of Gas Oils and a New Method for Their Laboratory Evaluation."

Determination of the stability of gasoline in sunlight by the adaptation of the oxalic acid—uranyl acetate actinometer will be described by O. M. Reiss, of the Standard Oil Company of New York, who made comparisons under varying conditions of intensity and at different temperatures.

Wheeler G. Lovell, John M. Campbell, and T. A. Boyd, of the General Motors Research Laboratories, Detroit, will read a paper on studies on detonation. Elizabeth W. Aldrich will address the chemists on "The Solubility of Water in Aviation Gasolines."

Engineering Tour Of Russia

RUSSIA, with its multitudinous new experiments in nearly every aspect of engineering, as well as in industrial management, will be the object of intense practical study and observation this summer when a tour to that country will be led by Parker H. Daggett, dean of the College of Engineering at Rutgers. Under the direction of Prof. N. C. Miller, head of the Rutgers University Extension Division, Russia and Europe will likewise be toured by a party of educators and a party of travelers studying social conditions.

It is expected that in the engineering division of the tour, the American engineers will be provided with a singularly close view of the work being carried on in Russia during this crucial period. Under Dean Daggett's direction a number of important factories and industrial plants will be visited and a series of conferences with engineers, business executives, labor leaders, and men of outstanding importance in the political field has been arranged. Practical education and engineering will be combined in their most effectual forms through a course in engineering economics to be conducted en route.

The course will consist of a critical study of the work of professional engineers in the various countries visited. A comparison will be made of American and European manufacturing methods, production, and management problems. Special attention will be given to the "Five-Year Plan" in Russia.

Chemical Exposition In Japan

The Third Chemical Industries Exhibition under the auspices of Kwagaku Kogyo Kyokwai—the chemical industries association of Japan—will be held at Tokio from March 20 to April 30. Leading producers of Japan will participate in the exposition and the varied exhibits are expected to illustrate the development which has taken place in recent years in the Japanese chemical industry.

Methanol Makers Adopt New Precautions

FROM the first distribution of methanol for anti-freeze, important precautions have been taken by synthetic manufacturers to insure that diversion to beverage purposes shall not result seriously through anything but gross carelessness or deliberate action of those handling or using this product. The anti-freeze methanol has been colored distinctively, in order that no one would confuse it with grain alcohol. Containers have been conspicuously labeled to show the character of the material, and dealers have been cautioned regarding proper methods of handling.

Recently it has been decided that the addition of an emetic is desirable, and at least two of the principal makers are including such modifying compound in their anti-freeze grade of methanol. One maker has included brucine in order that the bitter flavor would serve as an additional warning to would-be drinkers. Active co-operation of federal authorities is being had in this work to insure the earliest possible use of the most suitable modifying constituents, both emetics and "unsavorers." All of the federal authorities who have been disturbed by reports, many of which were unfounded, that methanol was being mistaken for denatured alcohol and was causing death and blindness, regard these developments as highly important.

Synthetic methanol makers also are collaborating with state authorities in the furthering of legislation which will properly restrict the distribution of methanol to legitimate channels and protect the public against inadvertant misapplication.

Potash Developments in New Mexico

OPERATING at a point 22 miles east of Carlsbad, N. M., the United States Potash Company has developed by means of drilling some large and very promising potash deposits. A four-compartment shaft extending to a depth of over 1,000 ft. has been sunk and production has been started from the main level near this depth. Equipment to grind and sack 400 tons per day of mine-run material running as high as 30 per cent potash has been placed in operation. The potash is present as potassium chloride.

Leading Engineers Will Conduct Summer School

METHODS of teaching the basic courses of chemical engineering curricula, with particular emphasis on the unit operations and the application of the principles of chemical engineering in industrial processes, are to feature the Summer School for Engineering Teachers which will be held at the University of Michigan, Ann Arbor, June 23 to July 9. Sponsored by the American Institute of Chemical Engineers and largely made possible by the financial support of the Chemical Foundation and the University of Michigan, the session promises to be one of the most popular in the long series held annually under the direction of the Society for the Promotion of Engineering Education.

Prof. Alfred H. White is to serve as the local director with Prof. W. L. McCabe assisting as local secretary. The staff will comprise teachers and practicing engineers selected from among the leaders of the profession.

The portion of the program relating to methods of teaching will be in charge of a group of prominent teachers of chemical engineering from institutions throughout the country. Among these are the following: W. K. Lewis, Massachusetts Institute of Technology; W. L. Badger, University of Michigan; R. S. Tour, University of Cincinnati; H. L. Olin, State University of Iowa; J. R. Withrow, Ohio State University; John C. Olsen, Polytechnic Institute of Brooklyn, and president, American Institute of Chemical Engineers; W. H. McAdams, Massachusetts Institute of Technology; O. R. Sweeney, Iowa State College; W. L. Beuschlein, University of Washington; A. W. Hixson, Columbia University; G. H. Montillon, University of Minnesota; B. F. Dodge, Yale University; G. G. Brown, University of Michigan; G. A. Bole, Ohio State University; A. W. Davison, Rensselaer Polytechnic Institute.

Chemical engineering applications will be presented in a series of lectures by practicing engineers and industrialists. Members of the staff from the field of industry will include Harry A. Curtis, chairman, Division of Chemistry and Chemical Technology, National Research Council, and director of research, Vacuum Oil Company; R. E. Wilson, assistant to vice-president in charge of manufacturing, and head, development and patent department, Standard Oil Company of Indiana; Zay Jeffries, consulting metallurgist; Clifford Paige, president, Brooklyn Union Gas Company, and president, American Gas Association; L. V. Redman, vice-president in charge of research and development, Bakelite Corporation; E. S. Rothrock, assistant manager, Texas Chemical Company, and Louisiana Chemical Company, Inc.; George Oenslager, research chemist, B. F. Goodrich Company; J. V. N. Dorr, president, The Dorr Company; Ralph Hayward; general manager, Kalamazoo Vegetable Parchment Company; L. V. Burton, editor, *Food Industries;* C. O. Brown, treasurer, Nitrogen Engineering Corporation, and consulting engineer; E. C. Sullivan, vice-chairman, Corning Glass Works; S. D. Kirkpatrick, editor, *Chemical & Metallurgical Engineering;* C. C. Furnas, research chemist, U. S. Bureau of Mines Experiment Station, University of Minnesota.

Final details of the program are to be published in the April 15 issue of the *Journal of the Society for the Promotion of Engineering Education.* Prof. H. P. Hammond, director of the Summer School for Engineering Teachers, 99 Livingston Street, Brooklyn, N. Y., is already receiving applications for admission to the course. These should be in the form of letters stating name, academic title, and the institution of the applicant.

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Electrochemists Will Meet In Birmingham

THE spring meeting of the Electrochemical Society will be held April 23-25 in Birmingham, Ala. Headquarters will be at the Hotel Tutwiler. Electrochemistry and ceramics will feature the opening symposium. Electric kilns, melting points of refractories, electric furnace linings, fused alumina, and silicon carbide will be discussed at this session.

The recent advances in hydrogenation will be the topic for discussion at the round-table luncheon on Thursday. Dr. W. D. Richardson, of Swift & Company, will preside at this informal meeting.

Prof. Herman Schlundt will conduct the session on electronics. Seven papers are scheduled for this meeting. The session on electrometallurgy Saturday morning will bring the meeting to a close. Emphasis will be laid, in particular, on the deposition of gold and the platinum metals, but there also will be papers on nickel, chromium, silver, zinc, cadmium, and lead.

Visits to industrial plants include the Alpha Portland Cement Company, American Cast Iron Pipe Company, Republic Iron & Steel Company, Harbison-Walker Refractories Company, Swann Chemical Company, Goodyear Tire & Rubber Company, Tennessee Coal & Iron Company, and the Gulf States Steel Company.

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Philadelphia Quartz Co. Celebrates Anniversary

THE one-hundreth anniversary of the Philadelphia Quartz Company was celebrated by a dinner on Jan. 26. About 200 people were present, including the personnel of the various departments at the general offices, out of town sales representatives, and a group from the factories. The oldest person present was John McNamee, who became associated with the company 60 years ago.

William T. Elkinton, chairman of the board of directors and grandson of the founder, Joseph Elkinton, reviewed sketchily the historical background of the company.

Student Courses at Chemical Show

THREE courses for students have been outlined in the program of the Exposition of Chemical Industries which will be held in New York City, May 4-9. The first course, scheduled for May 4-5, is intended for students who are beginning their work in chemical engineering but who have had none of the formal courses in the subject, and for students who are interested in chemical industry and have not yet made final decision as to their future course of study.

The first day will be devoted to some general principles, the course being opened by a lecture on "Unit Operations versus Processes." Other talks are planned on "Heat Transfer," "Handling of Materials," and "Materials of Construction." On the second day several typical unit operations will be discussed. No attempt will be made to describe equipment in detail or to cover equations and calculations, attention being centered on giving students a general idea as to the part these operations play in chemical industry. The last lecture of the course will be on "Chemical Engineering as a Career." The afternoons will be devoted to studying materials and equipment, preferably under the direction of the students' own instructors, but with supervision provided for those who are not in class groups.

The second course, to be held on May 6-7, is designed for advanced students of chemical engineering and for younger chemical engineers in industry. Its purpose is to give the young chemical engineer the point of view which is held by the progressive leaders in this field. The first day's program will begin with a discussion of commercial surveys of markets, prices, raw materials, and similar factors which precede development of a chemical industry. Another lecture will cover some of the more recent inventions such as new alloys and electron tubes, and what changes and advances in chemical industry they have made possible. It is also planned to have a discussion of the utilization of small scale chemical engineering equipment in the development of new large-scale operations. The second day will be devoted to the use of high pressure in chemical industries.

The third course, May 8-9, is for students of chemistry, including advanced undergraduates, graduate students, and younger chemists who are still under training. The first day will have as its theme the services of the chemist. Talks will cover the general topic of chemistry as a career, and the special service of chemists in the plant, chemists working with chemical engineers, chemists as consultants, and chemists as expert witnesses. The second day's program will have to do with the training of the chemist in the university, in industrial fellowships, and in the plant. During the afternoons, studies will be made of the equipment which will be on exhibition.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

THERE is a strong feeling of resentment in all countries when their manufacturers establish branch plants in other countries. This feeling has been particularly strong in the United States, but regardless of the impression it creates, the trend seems to be toward more foreign branches. This is justified by the manufacturers, who contend that they have pioneered the field in other countries and have established a market for their product. When tariffs or other restrictions are set up which close a market to their American plants, they are not willing to surrender the trade they have built up, and establish a branch plant.

Many observers are of the opinion that this internationalizing of industry will proceed at an accelerated rate. Some countries are offering special inducements for such plants and certainly they are welcome in all countries, including the United States.

The question recently has been raised as to what should be the attitude of government agencies toward American plants in other countries. Some contend that they should have every assistance, since the profits of the enterprise come back to the United States. The point also was made that many of these plants contribute importantly to improved living standards in the countries where they are located. Since better living standards in other countries is the greatest potentiality offered American business, many are of the opinion that no service should be withheld from such branch operations.

The other side of the picture is that these plants, employing foreign workmen, reduce to a material extent the output of the home plants and that in the long run the effect will be to nullify the effects of a protective tariff.

GUM spirits of turpentine and gum rosin having been declared agricultural commodities by act of Congress on March 4, the Gum Turpentine-Rosin Co-operative Marketing Association, organized in October, 1930, now enjoys immunity from the anti-trust laws under the terms of the Agricultural Marketing Act and is eligible for loans from both the intermediate credit bank of Columbia, S. C., and the Federal Farm Board.

Rebuffed by the Federal Farm Board, which declared last year that the oleoresin producers are not farmers and therefore could not qualify for a loan from the $500,000,000 revolving fund earmarked for agricultural co-operatives, the association applied to the Federal Farm Loan Bureau for a loan from the Columbia bank to finance its marketing operations.

Loans made by an intermediate credit bank may not exceed 75 per cent of the market value of the product pledged, and in practice 65 per cent is the usual maximum. As this is raised to a theoretical 100 per cent by the Agricultural Marketing Act, the turpentine producers now are in a position to apply for an additional advance from the Federal Farm Board. Farm Board advances ordinarily do not exceed 85 per cent and it is doubtful whether the association will apply for any advance beyond that to be made by the intermediate credit bank. It is even more doubtful whether the association would be able to convince the Farm Board that more funds are needed than can be obtained through the credit bank.

SCHEDULED to become effective March 1, there is no assurance that the new regulations governing the use of industrial alcohol will become effective on April 1. The final draft has been waiting for weeks for official approval by Attorney General Mitchell and Secretary of the Treasury Mellon. Officials of the Bureau of Industrial Alcohol state that although they have expected from month to month that the regulations would become effective in the following month, they cannot now even hazard a guess on the effective date.

The McKellar bill and others intended to regulate the sale and use of methanol failed to reach enactment before adjournment of Congress on March 4, but the Bureau of Industrial Alcohol is closely scrutinizing the sale of methanol as an anti-freeze to determine whether the public is being properly safeguarded. Agents of the Bureau have been instructed by Commissioner Doran to report any instances in which methanol may have been sold as denatured alcohol. It is understood, on the other hand, that methanol manufacturers have issued strict instructions to distributors to sell methanol as and for what it is.

In compliance with the Broussard resolution, Secretary of Commerce Lamont submitted to the Senate prior to adjournment an explanation of the co-operative arrangement made by the Bureau of Mines with methanol producing companies for the investigation, which so far has disclosed that methanol can be used as an anti-freeze without hazard to human health if reasonable precautions are observed. Declaring on the Senate floor that he did not regard Secretary Lamont's reply as a frank compliance with the resolution, Senator Broussard moved for an investigation of the Bureau's activities in toxicology, but this proposal was lying on the table when the Senate adjourned March 4.

Forty-four states have held legislative sessions this winter. While taxation has been the primary issue, due to the fact that 24 states are running in the red and are confronted with the necessity of raising more revenue, many measures have been proposed and several have reached enactment which are of direct interest to the chemical industry. Such legislation follows several general lines:

1. Agricultural poison acts, involving regulation by a designated state board of insecticides, fungicides, and, in certain cases, bactericides and herbicides.
2. Revision of pharmacy laws involving the definition of poisons proposing either labeling or restriction of sales.
3. Legislation on narcotics designed to prohibit the sale of cannabis indica, marijuana (Indian hemp), and peyote; and other measures to permit the sale only on written prescription of sedatives such as barbital, chloral hydrate, and luminal.
4. Bills proposing regulation of fumigation and the inspection of gasoline and other inflammable liquids, intended to promote safety or to prevent fraud.
5. Bills providing for the labeling of paints and allied products to prevent misrepresentation.
6. Legislation with respect to the sale of anti-freeze compounds which are either regulatory or prohibitory in character.

A meeting of the traffic committee of the Manufacturing Chemists' Association on March 19 was followed by meetings on March 20 of the carboy committee and the poisonous articles and miscellaneous package committee. The traffic committee debated current problems involving the ratings on metal containers, the new class rates that probably will become effective Sept. 1, and stop-off privileges in the Southwest. The carboy committee is working toward standardization of carboys for corrosive liquids and the poisonous articles committee is engaged in developing new containers to increase safety and introduce greater economy into the transportation of chemicals.

It is expected that the Interstate Commerce Commission will soon enter an order authorizing the use of the 5-E drum single-trip container, better known as the one-time shipper, for the transportation of alcohols and solvents.

Creosote oil is the first chemical commodity now on the free list in which the Tariff Commission has undertaken an investigation, in response to Senate resolution, to determine the rate of duty necessary to equalize the difference in foreign and domestic costs of production based on the American selling price as defined in Section 402 (g) of the 1930 tariff. The Senate resolution was sponsored by Senator Copeland, of New York, at the request of manufacturers who failed in their efforts to obtain a duty on creosote oil, because of opposition from wood preservers.

While it appears that some exception may be taken to statements made in correspondence between the Bureau of Mines and the Methanol companies, several decades of experience in the financing of government research by private industry demonstate that there is no question of the soundness of this principle.

Agricultural Chemicals Find Large Outlets in France

Nitrogen, Potash, Copper Sulphate, and Sulphur in Wide Demand

From Our Paris Correspondent

GENERALLY speaking, last year was not very favorable for the French chemical industry, although it was, perhaps, less discouraging than for other industries. The business crisis which has grown continually worse and of which the end is not yet in sight, has especially depressed the textile and metallurgical industries. A curious point is that prices of chemicals have shown very little fluctuation and are approximately the same as those for 1929. Only at the beginning of this year has the price of alkalis shown a slight decline. Exception must be made, however, for potash, phosphoric and nitrogen fertilizers, which have followed world prices steadily in decline, and there also has been a decline in nitric-acid prices.

Agriculture plays an important part in extending the use of chemicals in France. We have previously pointed out that the International Convention has left the French industry free to produce its nitrogen fertilizers nearly to its full capacity, which is, however, relatively small compared with that of other big industrial nations. The three methods employed for the synthesis of ammonia are the Claude process, the Casale process, and that of the Nitrogen Engineering Company (N.E.C.). The Claude process is utilized by six factories and is able to produce 155 tons per day. The Casale process, which is by far the most widely employed, obtains 323.5 tons of ammonia per day, of which half is produced by the Office National De L'Azote at Toulouse and the N.E.C. process, utilized by the Kuhlmann concern and producing 75 tons per day. The total production is approximately 550 tons per day; i.e., 165,000 tons per year, corresponding to 135,000 tons of pure nitrogen, whereas French consumption is about 200,000 tons of pure nitrogen per year. This being so, the time is approaching when the French industry will satisfy the home market. Already German imports of sulphate of ammonia have decreased proportionally, as also have imports of Chilean nitrate, which during the first nine months of 1930 diminished by 227,000 tons as compared with the same period of 1929. In addition, the Office National De L'Azote is setting up the B.A.M.A.G. process for the oxidation of ammonia to nitric acid on a large scale, which will result in a further decline in nitric-acid imports.

IT IS interesting, on the other hand, to note the growing employment of potash fertilizers for agriculture which increased from 60,000 tons (estimated in pure potash) in 1919 to 240,000 tons in 1929, a gain of 300 per cent. As the Alsatian potash mines produce 450,000 tons of pure potash, it is seen that over one-half of the production is employed in home consumption. Certain experts are of opinion that this proportion will increase, as the consumption of phosphoric fertilizers, calculated as phosphoric anhydride, is 480,000 tons and the proportion of potash to phosphoric anhydride is, in the cereals, 3 : 5, which would, therefore, require 290,000 tons of pure potash.

Among other products used in agriculture is sulphate of copper. French production, which is only approximately 50,000 tons, is not sufficient for the home needs, as during the first three months of 1930 France imported 15,000 tons, valued at about 45 million francs. There also has been a decline in imports of this product, as the total for 1929 was 17,000 tons, valued at 55 million francs.

A further product which is used mostly by the wine growers, is sulphur, which is nearly all imported. It is refined at Marseilles, Sète, and Bordeaux, the first-named port receiving a part of its supply from Sicily, and the latter from the United States. More than 120,000 tons is used by the wine growers, other industries using at least 30,000 tons. It should be noted that this product is not employed for the manufacture of sulphuric acid. The tonnage of refined sulphur having reached important figures, certain companies have by this fact become very big and this has led to a merging movement in this industry. A case in point is that of the Raffineries De Soufre Réunies, which controls nine works, having recently absorbed another factory at Dunkirk, established one at Bordeaux, and is now building a refining plant at Algiers to meet the demand of wine growers in Algeria.

THERE is reason to emphasize the importance which has been gained by the coal mines from the point of view of the chemical industry. This may be seen not only by the above-stated figures for production of ammonia obtained as a byproduct of coal-carbonization but also by the growth of synthetic products.

Thus, the Béthune mines produced during 1929-1930 1,150 tons of methanol, 600 tons of formaldehyde, and 1,285 tons of ethyl alcohol. The Courrières mines have a producing capacity of 3,600 tons of methanol, the Lens mines are establishing the manufacture of methanol, and the Marles mines that of ethyl alcohol starting from coke-oven gas. The mines have been brought into developing this industry, which pays well, by reason of foreign competition in the coal trade, imports becoming more and more important. Indeed, for coal requirements during 1929 or from 85,000,000 to 90,000,000 tons (including agglomerates and coke) the French coal production was about 55,000,000 tons, the imports being nearly 25,000,000 tons of coal, 5,500,000 tons of coke, and 1,500,000 tons of agglomerates. The figures increased during 1930.

AN INDUSTRY which shows a tendency to disappear in France is that of natural silk, the production of which is steadily diminishing. This industry is located in certain counties—chiefly Gard, Ardèche, Drôme, and Vaucluse — where about 80,000 silk-worm farms exist with an output during 1929, in cocoons of about 2,500,000 kilograms. This corresponds to 195,000 kilograms of silk, whereas the production of silk during 1928 was 240,000 kilograms; during 1911, 400,000 kilograms; and three quarters of a century ago attained 2,500,000 kilograms. To help this industry it is hoped to obtain from Parliament a vote of compensation for the silk-worm farms in the shape of a bounty on the production of the silk-worm eggs and suppression of the tax on the turnover. But it is feared that these remedies will come too late to effect the desired result. In any case French production accounts for only a small part in the quantity of silk manufacture, in the Lyons center notably, which amounts to 6,000,000 kilograms per annum, nearly 95 per cent being imported.

Canadian Laboratory Devises Alcohol Process

A PROCESS for manufacturing industrial alcohol from natural gas waste is reported to have been developed in the laboratories of the Canadian National Research Council, according to the Department of Commerce. This process is regarded as a means of utilizing the large waste of gas in the Turner Valley oil field of Alberta.

Officers of the research council are now studying the economic possibilities of the process which has been developed. It is stated that the operating cost, excluding overhead and any other charges made for waste as required, would not exceed 25 cents per gallon. Industrial alcohol used annually in Canada at the present time is valued at more than $2,000,000.

If applied to only the so-called stabilizer gases, the process, it is estimated, could yield industrial alcohol to the extent of 10,000,000 gal. a year.

Dr. A. Cambron, senior chemist at the National Research Laboratories, is reported to have developed a process whereby the waste gas can be converted readily into ethylene, from which alcohol and other chemicals, including glycol, can be made.

Liquefaction of Coal Makes Little Progress in Germany

Phenol Recovered From Coke and Gas Plant Liquors

From Our Berlin Correspondent

ON THE whole, the generally unsatisfactory conditions in business are continuing. Such individual products as pharmaceuticals are showing more life, but price pressure continues to affect most of the heavy chemicals. Tar products are another exception, especially consumption of tar for briquetting in both domestic and foreign markets. This has allowed the stock of tar to decline considerably. Tar for roads is entering into competition with asphalt and imported bitumen; tar oils for impregnation also are doing well.

Speaking on the present status and technology of fuel production, A. Thau reported at the meeting of the Technical Fuel Association that overproduction in natural oil has greatly retarded development on liquid fuels from coal. In spite of the new petroleum sources in Hannover, which yielded a production of 200,000 tons of petroleum in Germany last year, a very considerable fraction of petroleum must still be imported. The high tariff offers the possibility of replacement in part by gasoline from coal. Low-temperature tar, which for a long time suffered from an overstock in regular coke, is gradually recovering since experiments for improving a special coke oven for uniting foundry coke with tar production have been successful. Hydrogenation of coal, especially lignite, is considered by Thau as a promising, although still overrated, source of oil. On the occasion of the general meeting of the I. G. Farbenindustrie, Bosch remarked that hydrogenation of coal will still find a technological solution. At present, however, the synthetic modification of fuels is still confined to the hydrogenation of heavy liquid oils.

THE I. G. has developed a new combustible material under the name of "Bonalin." It is injected into tubes, where it becomes a hard paste but has the property of becoming a clear water-white liquid on being pressed out of the tube. This liquid is used to fill lighters, where it is desirable because of easy ignition, complete combustion, and slow evaporation.

The automobile industry is chafing under the obligatory use of alcohol. In other countries where alcohol is used for automotive fuel, the alcohol is never, as in Germany, derived from potatoes; furthermore, the cost of production usually is lower than the retail price of gasoline. Potato alcohol, however, cannot be expected to drop as low as 30 m. per 1,000 lit. in price, even by the most economical technique, and this would still be more than 100 per cent over the import price of gasoline. Economically, therefore, potatoes would be automatically excluded from the picture of fuel. On the other hand, the large-scale production of alcohol through saccharification of cellulose seems to be possible in Germany at a price which would be under that of gasoline. The production of alcohol from sulphite liquor and acetylene might be even more economical, but today the German automobilist must cut his fuel with expensive potato alcohol for the benefit of the suffering farmer.

AN interesting investigation on the possible utilization of coke breeze in Upper Silesia has been prepared by Damm and Wesemann, occasioned by the increasing coke production in the western and eastern part of this territory, as well as through the fact that the zinc industry, which used to absorb any available quantity of breeze is shifting more and more to the electrolytic process. Because of its calorific inferiority, this breeze offers difficulties in addition to its low ash fusion point. The authors, therefore, suggest the following fields of consumption with calculated thermal price values: (1) Reducing agents in zinc refineries, 8m. per ton; (2) combustion fuel, 6.0m. per ton; (3) gasification fuel, 5.35 to 6.02m. per ton; (4) addition to coking coal, 4m. per ton; (5) briquetting, 9.5m. per ton.

The application of atomic hydrogen is making further progress; for example, Bonhöffer has observed that a drop of oleic acid is reduced to stearic acid by atomic hydrogen. Nagel and Piedemann have undertaken to study this reduction on a large scale, and succeeded in reducing 600 g. of oleic acid so that after six hours only 3.5 per cent remained. About 30.5 per cent was obtained as saturated acid and 66.2 per cent as polymerized product. Aromatic compounds gave favorable results too, but since the experiments were carried out under high vacuum (0.5 to 2 mm. of mercury), this method is suitable only for low-volatile substances.

A new process for recovering phenol from coke- and gas-plant liquors involves the use of tricresylphosphate, which is manufactured in Germany on a large scale by the I. G. Farbenindustrie. It is supposed to be far superior to the usual benzol process, since the phosphate has 16 to 30 times higher absorption power for phenol than has benzol. Tricresylphosphate is not volatile and only four to five parts is required for an extraction of 100 parts of water with 3 gr. of phenol per liter. This represents a great saving in power and extraction costs, and the separation of the phenol from the absorbent can be carried out by steam distillation in vacuum. After a period of operation the phosphate becomes laden with tarry substances and is finally regenerated by simple distillation in vacuum.

ALLOYS which usually are cast under atmospheric pressure have been subjected to hydrostatic pressure by G. Welter before their crystallization. Experiments were conducted under pressures from 500 gradually up to 20,000 atm. Resultant improvements in the material were proportional to the increase in pressure. Silicon aluminum alloys had their tensile strength increased from 10 to 20 per cent, and alloys hardened under high pressure in general showed a less porous and denser structure than those made by the normal methods.

The Walter Feld process for utilizing sulphur in coke-oven gases for ammonia removal involves the reduction of polythionate to thiosulphate through a mixture of ammonia and hydrogen sulphide. According to Raschig, this process is possible only when the ammonia and hydrogen sulphide are present in the gases in a ratio of two to one. According to a new modification developed in the I. G., the gas washing can be carried out in steps to completion, even if an excessive H_2S is present. Briefly, the economic results of the process for scrubbing 5,000 cu.m. of coke gas in 24 hours at the experiment station showed a 25 to 30 per cent lower cost than with previous processes.

The danger of mercury poisoning on the human system, which has been repeatedly emphasized, by Professor Stock, has been very much minimized by investigations of Borinski, of the Health Bureau of Berlin. The assumption that danger is indicated whenever mercury is found in the human system, is not longer valid, since it has been shown that 90 per cent of all mercury cases were the mere result of nutrition; that is, that all foodstuffs contain minute quantities of mercury. Danger through amalgam in dental work was possible only in 12 per cent of the cases. Therefore the number of persons endangered by mercury in daily life is much smaller than was assumed.

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British Columbia Plans Phosphate Development

THE British Columbia government is considering a proposal to reduce the 10 cents per ton tax on phosphate mined within the province. This proposal is being considered with a view to developing the phosphate properties of the Consolidated Mining & Smelting Company in the Kootenay area. Officials of the company have informed the government that if these properties prove up to the point where they can be profitably worked it is the intention of the company to develop the ores on a large scale, giving employment to one thousand men.

Keen Interest Shown in the Position Of Chilean Nitrate

British Capitalists Follow Closely Plans For Formation of "Cosach"

From Our London Correspondent

BECAUSE of the important position British interests have held in the nitrate of soda industry for many years, there has been keen interest evinced in everything connected with the formation of "Cosach." This interest has been heightened by the issuance of the annual report of Aikman, Ltd., under date of Feb. 18. While this report cannot be taken as an official presentation of the nitrate position, it comes from a firm which long has been prominent in the nitrate industry and which presumably is well posted on current developments.

The report reviews the nitrate industry for 1930 and outlines the plans originally adopted for the formation of "Cosach." Continuing, the report says: "The original scheme entailed the raising of a large sum of new capital, as, before the economic crisis had become acute, it was intended to build two important new plants. In view, however, of recent developments in the world's financial centers, these extensions will not take place at present, and other modifications further reducing the amount of new capital required have been made. The revised scheme will include a method of funding the guaranteed payments to the Chilean government for 1931-33 (the payment for 1930 has already been collected in the form of export duties), so that only the service of these will become a direct charge on the profits of 'Cosach.'"

THE report further says: "It is anticipated that 'Cosach' will include over 95 per cent of the productive capacity of Chile, and by working its cheapest producers at full production and keeping only sufficient going to supply the markets' requirements, the cost of production should not exceed £3 5s. per ton, f.o.b. Chile, and if to this is added the cost of service of the new bonds to be issued and debentures assumed, together with dividends on Lautaro preference and £12,500,000 'Cosach' preference shares, the gross cost f.o.b. Chile, including all the above charges and adequate allowance for amortization of plants, should not be more than £5 15s. per ton, based on present estimates of consumption, or even less if sales increase. On the basis of present freights this would mean a c.i.f. cost to the principal consuming markets of about £6 15s. per ton, whereas today's selling prices in the same markets are equivalent to about £8, 7s. 6d. per ton c.i.f.

"The cost of production of synthetic nitrogen products has been variously estimated at £5 10s. to £7 per ton f.o.b. factory in bags when working at full production, but at the reduced scale of working must today be considerably higher. To this must be added the cost of distribution from factory to consuming centers which, on an average, is little less than the cost of bringing nitrate from Chile, as so much of the movement has to be made by rail."

In the first place, the details published in the *Financial Times* are in the nature of an apologia explaining why the finance of the "Cosach" has been so difficult to secure, and why it has been found necessary to diminish the capital of the new concern very substantially from the £75,000,000 originally contemplated. It is evident that the building of both of the proposed new plants has been abandoned, though they were to have been the last word in carrying out the Guggenheim process. A cursory examination of the statement shows the reason. Before dealing with this, however, let us be clear that Chilean nitrate can never be the predominating element in the nitrogen industry: e.g., the virgin nitrate grounds which it is stated the Chilean government has ceded to the new company in consideration of the abolition of the duty are estimated to contain 150,000,000 tons of exportable nitrate.

Model of *Chem. & Met.'s* New Home

Thirty-five story building now under construction for the McGraw-Hill Publishing Company at 342 West 42d Street, New York City.

THE statement is made that Chilean nitrate can now be landed c.i.f. the principal ports for £6 15s. per ton, whereas the selling price is £8 7s. 6d. Naturally, with the removal of the duty of £2 10s. the c.i.f. cost is reduced, but this is not much more than a bookkeeping figure, as the government has to have its profit in another form. But let us just take this figure at its face value.

The nitrogen content of Chilean nitrate is 15.5 per cent, whereas that of nitro chalk is about 20 per cent; of ammonium phosphate, about 17 per cent; and of ammonium sulphate, 21 per cent. In comparing price values, account must be taken not only of the nitrogen content but of the value of the lime and phosphate to the soil which is being treated, whereas the soda in Chilean nitrate is not only valueless but sometimes harmful.

Metal Congress Held at San Francisco

TWELVE technical societies cooperated to carry out a fruitful program for the National Western Metal Congress and Western Metal and Machinery Exposition from Feb. 16 to Feb. 20 in San Francisco, Calif. Exhibitors to the number of 162 crowded the San Francisco Auditorium with an interesting show of new metals, machines, and methods. This part of the congress was unusually well attended, being viewed by over 50,000 visitors. Despite this remarkable attendance, the crowd was never uncomfortable, due to the arrangements made both as to time and space for the exhibits.

The papers, though chiefly of interest to the workers in the metallurgical, steel, automotive, welding, and gas industries, held some worth-while features for chemical engineers. F. N. Speller reviewed recent developments in prevention of corrosion of iron, steel, and related alloys. He stressed particularly the chrome-nickel-ferrous alloys, giving some attention to new alloys by which it is expected to overcome the undesirable properties of the "18-8" alloy. A paper by C. C. Snyder, on chromium and chrome-nickel steels, was presented by A. J. Wilson. This paper thoroughly discussed the carbide precipitation between 1,100 deg. and 1,700 deg. F., which is the disadvantageous feature of the "18-8" alloy. Dr. J. A. Gann, of the Dow Chemical Company, though unable to be present, sent an interesting paper on magnesium alloys.

MEN
IN CHEMICAL ENGINEERING

JOHN ARTHUR WILSON, who was chosen to receive the Nichols medal for 1931, received the official presentation on March 13 at a meeting of the New York Section of the American Chemical Society. J. G. Davidson, chairman of the jury of awards, presented the medal, whereupon Dr. Wilson spoke on colloid chemistry in leather manufacture and sanitation. Dr. Wilson, who was born in Chicago, received his education in New York and in England. He has been closely identified with progress in the leather industry almost since that time. He has contributed many of the new processes and is continuing work along this line as president of John Arthur Wilson, Inc., of Milwaukee.

D. H. KILLEFFER, of the DryIce Corporation, has become manager of the employment bureau of the Chemists Club, New York, which will be reorganized. He has also resumed his editorial connection with *Industrial & Engineering Chemistry.*

P. J. BYRNE, JR. recently returned from Germany and has been made head of the chemical engineering division of the Hydro Engineering & Chemical Company.

THOMAS T. MERRIFIELD, formerly chief chemist of the Mond Nickel Company, Coniston, Ont., and chief chemist at the zinc plant of the Consolidated Mining & Smelting Company, is now in charge of metallurgical work for J. T. Donald & Company, Montreal.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Swampscott, Mass., June 10-12, 1931.

AMERICAN CHEMICAL SOCIETY, 81st meeting, Indianapolis, March 30-April 3, 1931.

AMERICAN GAS ASSOCIATION, annual chemical conference, Philadelphia, May 20-22.

AMERICAN LEATHER CHEMISTS' ASSOCIATION, Atlantic City, May 27-29.

AMERICAN PETROLEUM INSTITUTE, mid-year meeting, St. Louis, April 15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Chicago, June 22-26.

ELECTROCHEMICAL SOCIETY, spring meeting, Birmingham, Ala., April 23-25, 1931.

EXPOSITION OF CHEMICAL INDUSTRIES, New York, May 4-9.

W. S. LANDES, since 1928 works manager and vice-president of the Celluloid Corporation, has been elected president to succeed John A. Stephens, who resigned recently. Mr. Landes is a graduate chemical engineer from the University of Pennsylvania, where he received his degree in 1914. He then entered the Westinghouse Lamp Company at Newark, and in 1916 entered

Kaiden-Keystone Studios

the army, eventually serving in France. Immediately on his return from the war, Mr. Landes began his uninterrupted connection with the Celluloid Corporation, starting in the film department.

A. RAFFERTY, president of Union Carbide & Carbon Corporation, has been elected president of the Niacet Chemical Corporation, Niagara Falls, N. Y.

E. S. BRUMBERGER, formerly of the duPont Rayon Co., Buffalo, and the Fiberloid Company, Springfield, Mass., is now associated with J. S. Hegeman, New York, in the development of textile and plastic processes.

B. J. RUSSELL, formerly engaged in work on naval stores, has been transferred by the Southern Kraft Corporation from the Mobile mill to the Panama City (Fla.) mill.

LOUIS GROSS, formerly president and general manager of the Gross Lead Burning & Coating Corporation, has severed his six years' connection to establish the Gross Engineering Company for lead burning.

LLOYD C. COOLEY, formerly of the Swenson Evaporator Company, has been appointed representative of the F. J. Stokes Machine Company, Philadelphia, for the Midwest.

LYNN A. WATT, who was manager of the development department of the Monsanto Chemical Works, St. Louis, has been elected assistant vice-president in charge of commercial and technical service of that company. Mr. Watt has been with the company for the past 11 years.

W. C. ASBURY, who was in charge of the chemical engineering department of the Hydro Engineering & Chemical Company, has left for an extended stay in Germany, where he will act as the company's representative in Ludwigshafen.

H. H. STORCH, who has been in charge of the U. S. Bureau of Mines experiment station at New Brunswick, N. J., has been appointed to take charge of the physical chemistry section at the Pittsburgh experiment station of the Bureau of Mines.

ORLANDO F. WEBER, president of the Allied Chemical & Dye Corporation, has been ill since last December and in order to hasten recovery has taken a leave of absence from the company's affairs.

CHARLES W. NICHOLS, son of the late William H. Nichols, long chairman of the board of Allied Chemical & Dye Corporation, has been appointed chairman of the executive committee of the company during the absence of O. F. Weber, president.

EVERETT P. PARTRIDGE, who has been engaged in boiler scale work at the University of Michigan and served as associate editor of *Industrial & Engineering Chemistry*, has been appointed supervising engineer of the non-metallic minerals experiment station of the U. S. Bureau of Mines, New Brunswick, N. J. He will devote himself exclusively to his new duties after April.

OBITUARY

CHARLES A. STRAW, vice-president and director of the Standard Oil Development Company, has died after a lingering illness of more than a year, at the age of 52. Mr. Straw was graduated from Harvard in 1901 and taught chemistry there and at Massachusetts Institute of Technology for the next seven years. He then entered the U. S. Patent Office and simultaneously studied law, getting his degree in 1912. After the war he was patent attorney for the Goodyear Tire & Rubber Company, whence he went to the Standard Oil Company (N. J.) in 1920. After seven years of patent work, he became vice-president of the new Standard Oil Development Company.

CHARLES WHITTEMORE, engineer in charge of safety for the Western Electric Company at Hawthorne, Ill., died on Feb. 27, following complications attending an operation last December. Mr. Whittemore had just finished serving the chemical section of the National Safety Council as president for 1930.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

DIRECTORS of Imperial Chemical Company, Ltd., have recommended a final common dividend of 3 per cent, making a total of 6 per cent for the year, less tax, payable June 1. This compares with 8 per cent paid during the previous year. No deferred dividend was declared, as was done last year, since under the articles of the association the deferred shares are not entitled to a dividend until the common stock has received 7 per cent.

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Virginia-Carolina Chemical Company is listing on the New York Stock Exchange 144,000 shares of 7 per cent preferred stock perpetual certificates in place of the present voting trust certificates, which voting trust expired March 1.

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Freeport Texas Company has acquired a controlling interest in Cuban American Manganese Corporation, owner of extensive manganese deposits in Cuba. No new financing will be required on the part of Freeport Texas Company.

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Directors of Cellulose Products, Inc., have approved the agreement for the formation of a committee to reorganize the company. Holders of Class A common stock are invited to deposit their stock, and the plan calls for the organization of a new corporation to acquire substantially all of the property and assets of Cellulose Products, Inc.

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In his annual report, H. I. Peffer, chairman of the board of the American Solvents & Chemical Corporation, said: "The company is in a favorable position because its requirements of molasses are assured with no obligation to purchase at a price higher than the current market prices from time to time or in excess of its production and sales requirements as against the long-term commitments heretofore necessary. All inventories have been written down to market, and future raw-material commitments have also been adjusted to the same basis. The company enters this year with a clean slate and with the benefits of improved operating and distribution facilities which the consolidation has brought about."

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Net incomes for companies in the chemical and allied industries as reported during the last month offer the following comparisons:

	1930	1929
Abbott Laboratories	$482,064	$591,013
American Commercial Alcohol	478,022*	1,395,716
American Metal Co.	1,827,578	3,252,879
American Solvents & Chemical	870,053*	800,628
Bon Ami	1,356,445	1,455,221
Celanese Corp.	1,919,950	2,952,321
Celluloid Corp.	259,275*	719,308
Congoleum-Nairn	208,839	2,213,831
Consolidated Chemical Industries	628,694	618,713
Corn Products Refining	14,067,689	16,309,651
Eagle-Picher Lead	1,919,465*	1,215,812
Freeport Texas	3,124,184	4,085,000
General Asphalt	1,006,795	1,757,095
General Printing Ink	850,557	1,378,540
Gold Dust	6,688,816	7,586,963
Heyden Chemical	302,402	483,519
International Printing Ink	181,308	2,119,154
International Salt	679,480	687,767
Lehn & Fink	1,706,771	1,721,608
Mathieson Alkali	2,096,007	2,324,276
Merck Corporation	271,585	428,080
Monsanto Chemical	732,684	1,691,338
National Distillers	307,286	609,389
National Lead	4,675,098	10,222,897
National Oil Products	223,599	134,748
New Jersey Zinc	5,013,403	9,221,794
Newport Company	865,404	1,682,285
St. Joseph Lead	4,076,460	9,730,742
Texas Gulf Sulphur	13,972,085	16,247,478
United Carbon	704,600	1,314,555
United Chemicals	476,150	899,950
Wood Chemical Products	101,375*	116,182

* Loss.

Price Range 1931 High	Price Range 1931 Low	Stock	Price Range in February Feb. 2	High	Low	Feb. 28
10½	5	Agfa Ansco Corp.	7	10	5	....
109⅝	92½	Air Reduction	95	109⅝	93½	102¼
5	¼	Ajax Rubber	¼	½	¼	....
182¾	153½	Allied Chemical	157¼	182¾	154	169½
178	140½	Aluminum Co. of America	148¼	178	140½	162
29⅝	20	Am. Ag. Chemical, Del.	24	29⅝	22⅛	26
14½	9	Am. Commercial Alcohol	....	14½	9	12⅜
12¾	7⅝	American Cyanamid, B	9⅝	12¾	7⅝	11¾
3½	1⅝	American Hide & Leather	....	3½	2½	....
23¾	16⅝	American Metals	17½	23¾	17	20⅛
4½	2½	Am. Solvents & Chemical	....	4½	3⅝	....
14½	7⅝	Anglo-Chile Nitrate	....	14½	9¾	13
18	15½	Archer-Daniels-Midland	16⅞	18	16¼	....
4½	3	Armour, Ill., A	3	3⅜	3	3⅜
23⅝	18	Atlantic Refining	20⅜	23⅝	20⅛	22¾
54	45½	Atlas Powder	48	54	48	....
60	50	Beechnut Packing	....	60	51	....
1⅞	1⅛	British Celanese	....	1⅞	1½	....
....	....	California Petroleum	....	....	....	....
10	5½	Celluloid Corp.	....	8	5½	....
4⅞	2¼	Certain-teed	....	4⅞	3⅜	....
11¾	11	Chickasha Cotton Oil	....	11¾	11	....
49⅞	47	Colgate-Palmolive-Peet	....	49⅞	47⅛	....
111⅝	73½	Columbian Carbon	91	111⅝	88	104½
21½	15¼	Commercial Solvents	17½	21½	17⅛	19⅜
86⅝	76½	Corn Products	81⅞	86⅝	80⅛	83⅝
23	13½	Davison Chemical	....	23	14¾	20⅛
19⅛	13	Devoe & Raynolds, A	15	19⅛	14⅛	....
51	45	Dow Chemical	....	50⅞	49	....
102⅞	83½	Du Pont	87¼	102⅞	85⅝	98⅛
121¾	118¾	Du Pont, 6 pc. deb.	120½	121¾	120⅛	121
3¼	2¼	Duval Texas Sulphur	2¼	2⅜	2¼	....
185¾	143⅝	Eastman Kodak	157	185¾	153¼	177
19¾	17	Firestone Tire	17½	19¾	17⅛	....
⅞	½	Fisk Rubber	¾	⅞	⅝	⅝
42	28½	Freeport Texas Sulphur	32½	42	32	37⅜
45⅛	24¼	General Asphalt	33¼	45⅛	32⅜	42⅞
16⅛	8⅝	Glidden	9⅞	16⅛	9	14
39⅝	31¼	Gold Dust	35¾	39⅝	35¼	37⅝
20⅞	15¼	Goodrich Co.	15¾	20⅞	15½	18⅝
57	52¾	Hercules Powder	....	57	52¾	....
13	12	Heyden Chemical	....	12	12	....
4⅛	4¼	Imperial Chemical, Ltd.	....	....	....	....
86	45	Industrial Rayon	....	86	45	78⅝
5¼	3⅛	Int. Ag. Chemical	....	5¼	3¼	4⅝
20½	13⅞	International Nickel	14½	20½	13⅞	19
10¼	6⅞	International Paper, A	....	10¼	8	8⅝
42	37¼	International Salt	37½	42	37⅝	39⅝
11¾	10	Kellogg, Spencer & Sons	....	11	10	11
2½	1⅝	Kelly-Springfield	1⅝	2½	1⅝	2¼
4	3¼	Lee Rubber & Tire	....	3⅞	3½	....
34¾	24	Lehn & Fink	27¾	34¾	27¼	33¼
15¼	11½	Libbey-Owens	....	15¼	11¾	14⅜
55⅛	41⅝	Liquid Carbonic	45	55⅛	45	52⅝
17	13	McKesson & Robbins	16	16⅛	14¼	15¼
31½	23¼	Mathieson Alkali	23¼	29	23¼	26⅛
25⅛	20	Monsanto Chemical	22	25⅛	21⅛	....
36⅝	19¾	National Distillers Products	....	36⅝	25½	30
132	118½	National Lead	123	130½	120½	127½
51	46¼	New Jersey Zinc	48¾	51	47½	48½
47	42	Newport Corp, A	43	47	42	....
19½	15⅝	Ohio Oil	17½	18¾	15⅝	17
39¾	33¼	Owens-Ill. Glass	....	38¾	35¾	....
16⅝	12¼	Phillips Petroleum	12¾	15⅝	12⅝	14⅛
42½	36	Pittsburgh Plate Glass	....	41⅞	41⅛	....
39½	36½	Pratt & Lambert	....	39½	36½	....
70⅝	63	Procter & Gamble	67½	70⅝	63⅛	70
11⅞	8¼	Pure Oil	9½	11½	9½	10⅛
....	....	Sherwin-Williams	....	....	....	....
12	5½	Silica Gel	7	12	6⅛	....
15⅞	10¼	Sinclair Oil	11⅞	15⅞	11⅝	14⅝
12⅞	8½	Skelly Oil	8⅞	11½	8½	9⅞
51¾	45¼	Standard Oil, Cal.	47¼	51¾	46⅞	49½
52½	45¾	Standard Oil, N. J.	47⅝	52½	46⅞	49¾
26	22½	Standard Oil, N. Y.	23⅞	26	23½	25
45¼	39½	Sun Oil	40	45¼	40	44
....	....	Swan & Finch	....	....	....	....
30⅝	28⅛	Swift & Co.	28¾	30¼	28⅝	30
9½	8½	Tennessee Corp.	8¾	9½	8½	9
36½	30¼	Texas Corporation	32⅝	35½	31½	34
55¾	45¾	Texas Gulf Sulphur	49	55¾	48½	55
9	6½	Tidewater Assoc. Oil	7⅝	8⅝	7½	8
16	3⅝	Tubize-Chatillon, B	4½	16	4⅜	9½
72	55½	Union Carbide	59½	72	58⅝	68
26⅝	22	Union Oil, Cal.	23⅞	26⅝	23⅝	24⅝
28¾	18¾	United Carbon	26⅝	28¾	24	26¾
77⅝	54	U. S. Industrial Alcohol	60⅝	77⅝	54	71⅝
10½	7	U. S. Leather, A	....	10½	9	10
17⅛	11¾	U. S. Rubber	13	17⅛	12⅜	16⅛
69¾	52⅝	Vacuum Oil	55¼	69¾	55½	63½
75¾	45½	Vanadium Corp.	50	75¾	48½	66⅞
3¼	2	Va.-Car. Chemical	....	3¼	2⅛	2¼
26¼	21½	Wesson Oil	21⅞	26¼	21½	25⅝
28	19¾	Westvaco Chlorine	25½	28	25⅛	27⅞
3⅜	2½	Wilson & Co.	3	3⅜	2⅝	3¼

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Wider Distribution of Chemicals And Related Products

Consuming Industries Increase Call for Raw Material Deliveries

BASIC INDUSTRIES reported considerable progress in February and enlarged operations in manufacturing lines had the effect of increasing demand for raw materials. The daily rate of steel ingot production was reported at an increase of 14½ per cent over that for the preceding month. Automobile production for the United States and Canada reached a total of 230 364 cars and trucks in February, as compared with 178,399 in January, or an increase of more than 29 per cent. Sales of textiles are reported to have progressed more rapidly than production and thereby brought about a reduction in accumulated stocks.

Consumption of crude rubber by manufacturers in the United States for the month of February is estimated to be 28,797 long tons, an increase of less than 1 per cent over the January consumption of 28,557 long tons, but counter to the usual seasonal decrease of 4 per cent, according to statistics compiled by the Rubber Manufacturers' Association.

REPORTS from the fertilizer trade indicate that a considerable falling off will be experienced in the movement of fertilizer chemicals in the present season. Tag sales for 16 states for February were reported to the National Fertilizer Association at approximately 63 per cent of those for February, 1930. On the same authority, production of superphospate in January was 29.1 per cent less than in January, 1930, although the January output was 3.1 per cent larger than that for December.

The leather industry likewise is slow to show recovery. The large volume of stocks on hand is indicated by figures of the Department of Commerce showing 4,726,272 backs, bends, and sides in the hands of tanners, dealers, and manufacturers on Jan. 31, compared with 4,690,835 on Dec. 31 and 3,328,776 on Jan. 31, 1930. Production of sole leather in January was 1,087,252 pieces and stocks in process at that date were 4,209,890 pieces.

Harness leather in stock on Jan. 31, 1931, amounted to 304,028 sides, as compared with 290,502 sides on Jan. 31, 1930; the total stocks of upholstery leather on Jan. 31, 1931, comprised 234,538 pieces, as against 241,870 pieces on Jan. 31, 1930; upper leather (cattle) in stock on Jan. 31, 1931, amounted to 4,572,726 sides, as compared with 4,655,568 sides on Jan. 31, 1930.

Comparison of activities in January with the corresponding month of last year reveals that manufacturing operations at the beginning of this year were more in line with the levels of the last quarter of 1930 than with those of the first quarter.

THAT productive operations were increased in February are verified by a statement from the Secretary of Labor which stated that there had been a general increase in the volume of industrial employment last month.

He said the increase constituted the first satisfactory indication of a general upward trend since the stock market collapsed in October, 1929.

The volume of employment index of Bureau of Labor statistics for manufacturing industries for February will show a gain of 1.4 per cent in employment over that of January of this year, the Secretary's statement said. The volume of payrolls will show an increase of 7.5 per cent in February over January.

These figures are based upon a comparison of 13,377 identical manufacturing establishments employing in February 2,772,219 workers having a weekly payroll in February of $66,567,283.

Usually employment and payroll indexes show an upward trend in February following the customary decreases in January due to inventory and repairs. The increase in employment, however, in January, 1930, was only 0.1 per cent; the increase in payrolls only 3.5 per cent.

The present increase compares favorably with those in years prior to 1930, and is the first satisfactory indication of a general upward trend since the stock market collapsed in October, 1929.

While industrial activities in most lines that are associated with the chemical industry, either as producing or consuming factors, were lower in January than was the case a year ago, improvement was registered in January over the rate maintained in the preceding month. From data now available the following comparisons can be drawn:

Production	**Dec. 1930**	**Jan. 1931**
Arsenic, crude, ton	1.483	2.803
Arsenic, refined, ton	1.439	1.570
Automobiles:		
Passenger cars, No.	122.748	139.814
Trucks, No.	31.533	31.577
Taxis, No.	1.425	512
Byproduct coke, 1000 tons	3.077	3.092
Cottonseed oil, crude, 1000 lb.	201.621	181.221
Cottonseed oil, ref., 1000 lb.	188.823	150.998
Plate glass, 1000 sq. ft.	4.941	7.331
Petroleum refined, 1000 bbl.	71.581	70.026
Turpentine, gum, receipts at Southern ports, bbl.	27.482	7.228
Stocks, bbl.	84.911	68.320
Rosin, gum, receipts at Southern ports, bbl.	117.489	41.345
Stocks, bbl.	372.090	329.626
Consumption		
Cotton, bales	406.207	454.188
Silk, bales	55.424	55.910
Wool, 1000 lb.	30.007	33.856

Export trade in chemicals has not been active and figures for January place outward shipments of chemicals and related products at a value of $8,897,370, as compared with $11,482,881 for January last year. Sodium compounds figured prominently in the decline in industrial chemicals, the totals being 39,723,099 and 52,045,063 lb. for January, 1931, and January, 1930, respectively. Benzol, which made a record in export trade, was exported in January to the amount of 2,976,588 gal.

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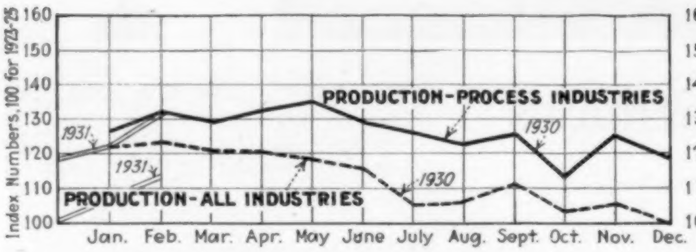
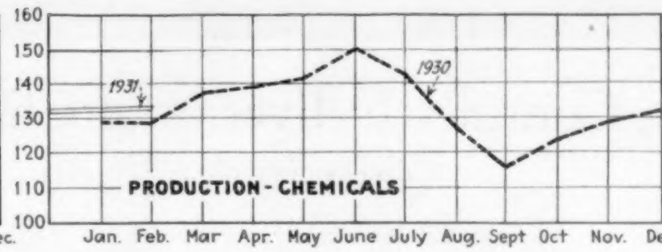
Sales of Plastic and Cold Water Paints and Calcimines

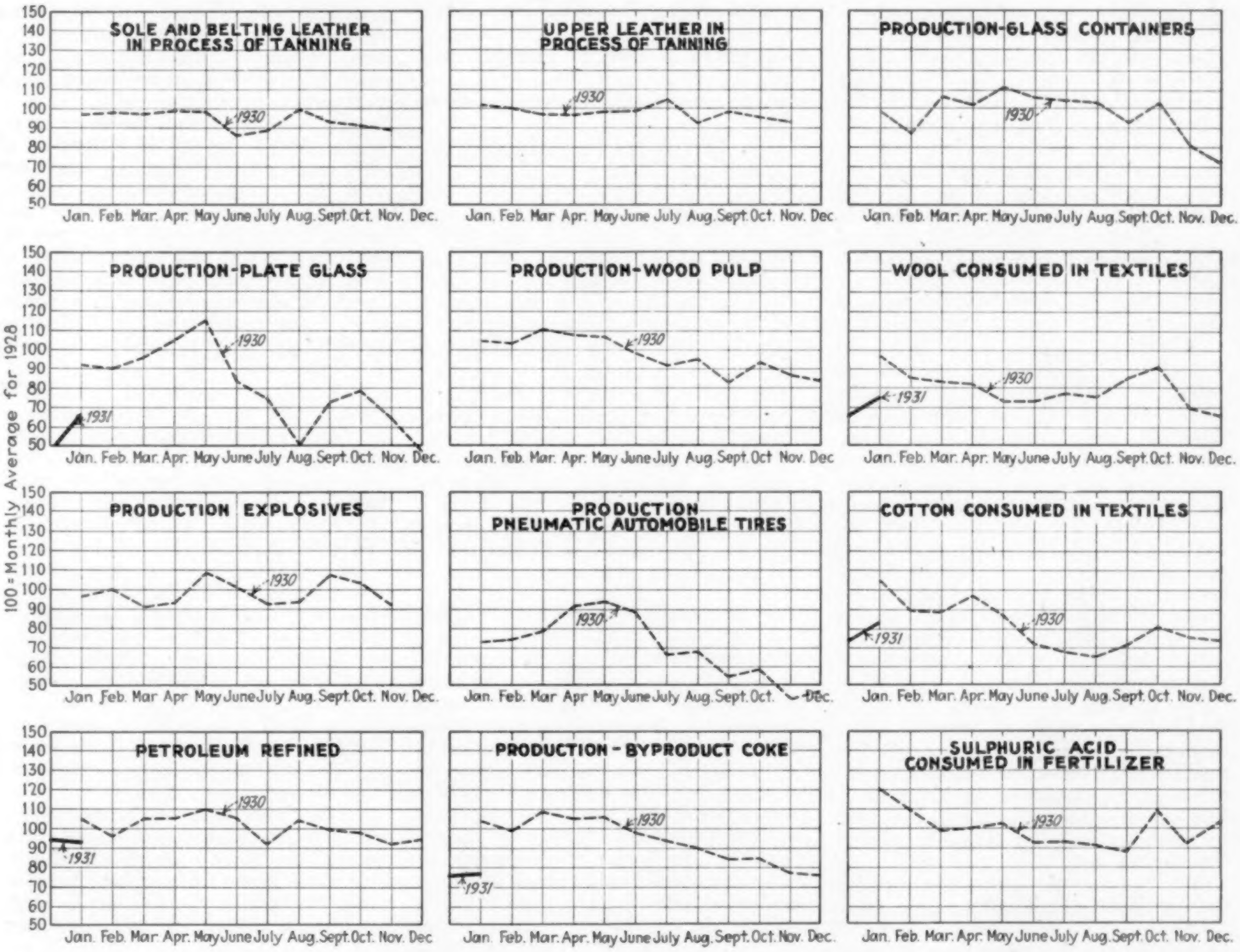
Months 1930	Lb.	Value	Lb.	Value
	Plastic Paints			
	Paste Form		Dry Powder Form	
Jan.	283,750	$39,166	578,473	$62,915
Feb.	372,414	52,784	649,825	74,481
March	432,437	58,692	856,752	96,046
April	420,589	56,973	794,890	89,446
May	331,629	46,067	654,238	70,738
June	285,525	40,515	496,007	57,873
July	280,952	36,275	634,575	71,036
Aug.	289,475	37,201	582,719	67,997
Sept.	343,909	44,823	512,921	56,292
Oct.	341,675	39,766	597,811	68,600
Nov.	428,727	43,129	442,888	51,847
Dec.	285,356	32,514	381,427	46,402
Total	4,096,438	$527,905	7,182,526	$813,673
1930	Cold Water Paints		Calcimines	
Jan.	1,084,219	$58,646	3,603,984	$160,012
Feb.	1,035,729	59,698	3,920,903	172,348
March	1,240,891	61,172	4,386,944	188,396
April	1,624,731	85,236	4,674,330	203,612
May	1,443,082	82,251	4,755,317	215,842
June	1,456,385	82,654	4 042,721	.75,960
July	1,135,120	63,017	3,751,129	163,448
Aug.	1,364,574	79,277	3,630,966	154,529
Sept.	1,108,178	53,788	2,612,968	106,379
Oct.	986,528	57,519	4,427,907	198,559
Nov.	584,136	29,613	2,990,625	132,284
Dec.	1,118,260	66,871	2,696,080	118,164
Total	14,181,833	$779,742	45,493,874	$1,989,483

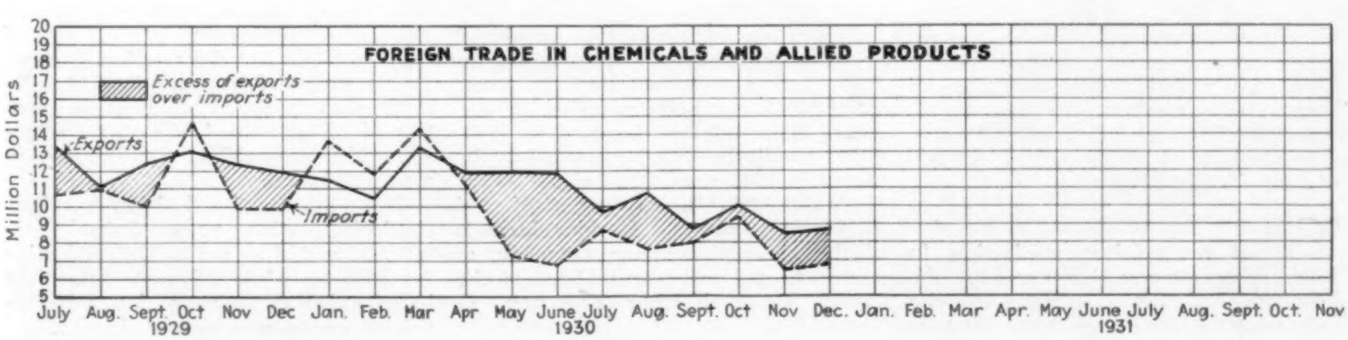
ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES





Based on electrical power consumption, data supplied by Electrical World





MARKET CONDITIONS AND PRICE TRENDS

Contract Deliveries of Chemicals Gain in Volume

Seasonal Increases in Movement of Chemicals During Last Month

IMPROVEMENT in the position of consuming industries was reflected in the market for chemicals last month. In the first place, there was an increase in ordering out chemicals against contract commitments. The paint, glass, rubber, and soap trades were reported to be showing more activity and to be taking on larger supplies of raw materials. Trading in the spot market was better than was the case earlier in the year, but did not reach a point where it could be described as active.

The volume of contract business placed for 1931 delivery is reported to be below the tonnage moved last year. This is explained on the ground that consumers were uncertain of their finished products fields and cut down on their raw material purchases as a precautionary measure. In other cases, and this is especially true of alcohol producers, considerable raw material was carried into the new year, and this tended to cut down buying power until such time as inventories will have been reduced. It is held, however, that reduced contract orders placed in the last quarter of 1930 will create more active trading in the spot market as the year advances.

The opening of a market for trading in blackstrap molasses futures, which occurred on Feb. 2, has not resulted in much trading to date. Asked and bid prices have fluctuated within narrow limits and apparently there has been no incentive to bring alcohol producers into the market.

Nitrate of soda attracted attention during the month because a previously determined sales schedule was succeeded by one in which prices were reduced. Reports that this material had sold at concessions also were current and combined with attempts to finance the recently formed nitrate combination in Chile, this material occupied a place of interest in the market. The slower position of the fertilizer industry is adversely affecting sales of nitrate as well as those of other fertilizer materials.

THE Bureau of Mines has issued a report on sulphur production in 1930. The output is placed at 2,558,981 long tons, which is an increase of 8 per cent over the output of 2,362,389 tons in 1929, the former record year. Shipments decreased, however, from 2,437,238 tons, valued at approximately $43,800,000, in 1929, to 1,989,917 tons, valued at $35,800,000, in 1930, or declines of 18 per cent in both quantity and in value. The large decrease in shipments is due principally to a decrease in exports from 855,183 tons in 1929 to 593,312 tons in 1930, a drop of 31 per cent. Domestic shipments decreased from 1,582,000 tons in 1929 to 1,397,000 tons in 1930, or 12 per cent. The high rate of production in 1930 accompanied by declining domestic shipments and exports resulted in an increase in producers' stocks from 1,928,000 tons on Jan. 1, 1930, to 2,497,000 tons at the end of December—a net gain of 569,000 tons.

Production in Texas was continued at all properties that were active in 1929, and a new property, at Long Point, was put into operation by the Texas Gulf Sulphur Company in 1930. Other properties that contributed to the output in 1930 were those of the Texas Gulf Sulphur Company at Gulf and Newgulf; Bryan and Hoskins Mounds of the Freeport Sulphur Company, at Freeport; and Palangana Dome of the Duval Texas Sulphur Company, at Benavides.

No sulphur was produced at the two properties in Nevada and Utah that have made small contributions to the country's output during the past several years.

Japan to Regulate Soda Ash Trade

A report from our consul at Kobe says that no agreement had been reached early in January, 1931, between foreign producers of soda ash on the one hand and the Japan Soda Ash Company, the Asahi Glass Company, and representatives of the Department of Commerce and Industry of the Japanese government with regard to the alleged competition of soda ash in Japan. It is understood that the Department of Commerce and Industry wishes to retain 70 per cent of the trade for the domestic industry, leaving the remaining 30 per cent to the foreign producers.

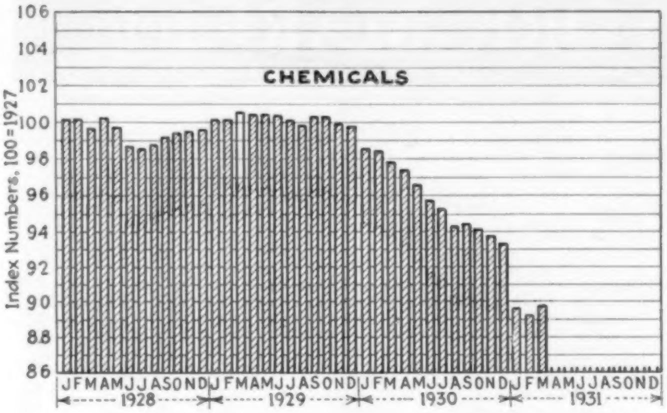
THE most important development in the market for vegetable oils in the last month was concerned with a request made by dairy interests that the Tariff Commission investigate production costs of oils with a view to protecting the home industry. The commission already had under way an investigation of foreign and domestic oils and at a hearing held last month the dairy interests protested that an investigation of costs based on invoice prices would not yield the correct information. Representatives of the soap, tinplate, and lubricating trades opposed any procedure which would affect importations of palm, rapeseed, and other vegetable oils. Perilla oil also was declared to be necessary in the production of high-gloss enamels and was declared to be noncompetitive with linseed oil.

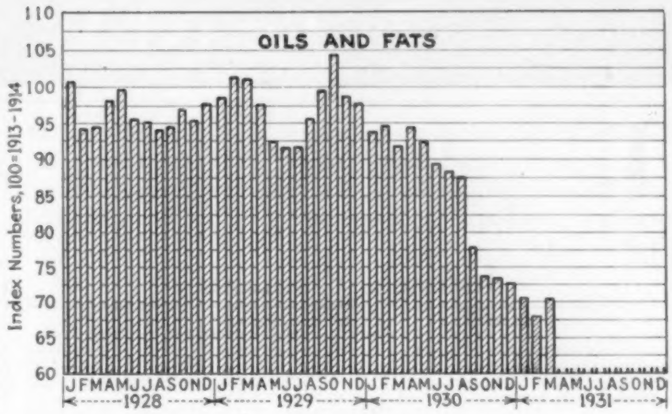
The greatest opposition was voiced against palm oil. A representative of the dairy interests, in discussing margarin production 1917 and 1927, two years of about equal productions, stated that the 1917 production used no palm oil, no sesame oil, no palm-kernel oil, 61,773,000 lb. of coconut oil, 96,378,000 lb. of oleo oil, 36,454,000 lb. of cottonseed oil, and 21,593 lb. of peanut oil; whereas in 1927 margarin manufacture consumed 955,000 lb. of palm oil, 129,000 lb. of sesame oil, 955,000 lb. of palm-kernel oil, 141,000,000 lb. of coconut oil, 45,477,000 lb. of oleo oil, 24,801,000 lb. of cottonseed oil, and 5,459 lb. of peanut oil. Palm oil is the future great menace to the dairy industry he declared.

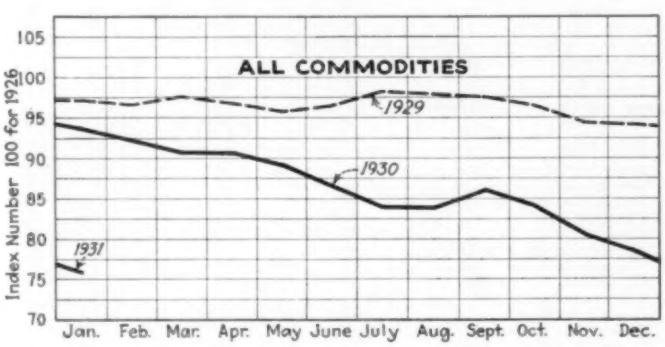
Another development in connection with the oil market was found in a report from abroad which stated that discussions were taking place between representatives of the five great whaling groups abroad and an agreement to curtail next season's fishing is expected. The present season's production is estimated at 3,000,000 bbl., an increase of 500,000 on 1929-30 and of 1,200,000 bbl. on the previous season. It has proved impossible to find sufficient markets for this enormous quantity of oil and the leading groups are attempting to stabilize the industry on a profitable basis.

While no definite decision has been reached it has been proposed that 1,500,000 bbl. would be a suitable production for 1931-32, while 2,500,000 bbl. might be regarded as an approximate indication of future economic production.

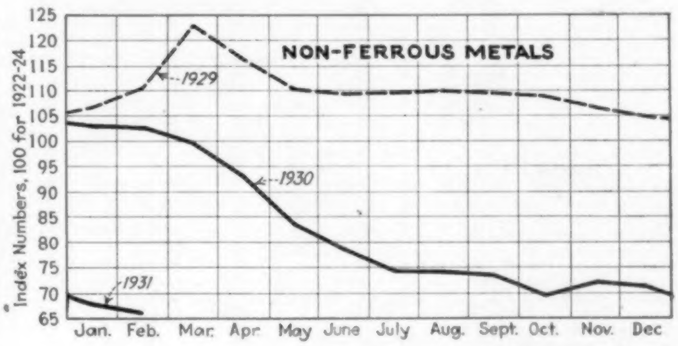
CHEM. & MET. *Weighted Indexes of* PRICES







U. S. Department of Labor



Engineering & Mining Journal

Steadier Price Tone Rules in Market for Chemicals

WHILE price cutting was not entirely eradicated in the last month, there was more of a tendency on the part of producers of chemicals to observe the quoted levels. With the active contracting season ended, selling competition naturally would be expected to be less keen, but there is reason to believe that current sales prices are low enough to discourage any further declines. Fluctuations in producing costs and in marketing conditions undoubtedly will affect price movements of some selections, but the majority of basic chemicals appear to have acquired a steadiness which should not be disturbed in the near future.

Any consideration of price influences for the present year must take into consideration the relative positions of production and consumption. Chemical production started off last year on a fairly high plane and tapered off in the latter part of the year. That position has been reversed this year. Producers have not raised their operating activities much above those ruling in the latter part of 1930. On the other hand, consumers in many cases have increased operations in the last month, and if the second quarter of this year lives up to present promises there will be no danger of accumulations of raw materials, and greater confidence in a continuance of steady price levels seems justified because of this probability.

The position of nitrogen-bearing materials offers an exception to the general rule. In the first place, the outlet afforded in the fertilizer industry has been contracted in recent months. Nitrate of soda showed weakness in the last month and the Chilean industry appears to be affected not only by competitive materials, but also by the delay in carrying out the original plans made for the establishment of a unified industry in Chile. The opinion is expressed that the original plans will not be carried out, and interest is keen to discover whether modified plans will include downward price revisions in order to guarantee volume of sales.

In the market for vegetable oils, crude cottonseed oil has been firmer, but the crushing season is so far advanced that crude oil does not reflect the position of the market as accurately as does refined oil, and the latter does not disclose an advancing trend in value. Linseed oil has sold more freely of late and spring requirements are expected to call for large deliveries, with the result that this oil is in a stronger position than other oils, especially as it is not affected by the interchangeability which marks trading in other oils.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**89.72**
Last month	89.16
March, 1930	97.90
March, 1929	100.50

A steadier tone characterized trading in chemicals throughout the last month. Price concessions were still noted in some cases, but they were less general and less important than earlier in the year. Turpentine aided materially in moving the index number upward.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**70.57**
Last month	67.92
March, 1930	91.79
March, 1929	101.11

Higher values for linseed oil furnished the chief development of the month. Crude cottonseed oil, while inactive, held above the level of the preceding month. Other oils and fats showed very little change during the month.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.11 -$0.12
Acid, acetic, 28%, bbl., cwt.	2.60 - 2.85	2.60 - 2.85	3.88 - 4.03
Glacial 99%, tanks	8.98	8.98 -	-
drs.	9.23 - 9.48	9.23 - 9.48	-
U. S. P. reagent, c'bys.	9.73 - 9.98	9.73 - 9.98	-
Boric, bbl, lb.	.06½- .07	.06½- .07	.06½- .07
Citric, kegs, lb.	.40 - .41	.40 - .41	.46 - .47
Formic, bbl, lb.	.10 - .11	.10 - .11	.10½- .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10½	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.23 - .35	.25 - .35	.35 - .40
Tartaric, powd., bbl., lb.	.30½- .33	.31 - .33	.38½- .39
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63 -	2.63 - 2.71	2.63 - 2.71
Alcohol, Butyl, tanks, lb	.15½-	.15½-	.16½- .17
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.236-	.236-	-
Denatured, 188 proof			
No. 1 special dr., gal.	.39 -	.39 -	.49 -
No. 5, 188 proof, dr., gal.	.39 -	.39 -	.50 -
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03½- .04	.03 - .03½
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	2.00 - 2.10
Aqua ammonia, 26°, drums lb	.02¾- .03	.03 - .04	.03 - .04
tanks, lb.	.02½- .02¾	.02½- .02¾	-
Ammonia, anhydrous, cyl., lb	.15½- .15½	.15½- .15½	.15½
tanks, lb.	.05¾-	.05¾-	-
Ammonium carbonate, powd. tech., casks, lb	.10½- .11	.10½- .11	.11 - .12
Sulphate, wks., cwt	1.60 -	1.70 -	2.10 -
Amylacetate tech., tanks, lb., gal	.222-	2.22 -	-
Antimony Oxide, bbl., lb.	.08½- .10	.08½- .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton.	58.00 -60.00	58.00 60.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033-	.033-	.033-
Bromine, cs., lb.	.36 - .38	.45 - .47	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	4.50 -
Arsenate, dr., lb	.07 - .08	.07 - .10	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton.	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06 - .07
Chlorine, liquid, tanks, wks., lb.	.01¾-	.01¾	.02½-
Cylinders	.04 - .06	.04 - .06	.04½- .06
Cobalt oxide, cans, lb.	1.75 - 1.85	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton.	13.00 14.00	13.00 -14.00	15.00 -16.00
Copper carbonate, bbl., lb	.08½- .18	.08½ .17	.13 - .20
Cyanide, tech., bbl., lb.	.41 - .46	.41 - .46	.45 - .46
Sulphate, bbl., cwt	4.25 - 4.50	4.00 - 4.25	5.50 - 6.00
Cream of tartar, bbl., lb	.23½- .24	.23½- .24	.26½- .27
Diethylene glycol. dr., lb.	.14 - .16	.14 - .16	.11 - .13
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.085-	.085	.121-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.07½- .08
Furfural, dr., contract, lb	.10 - .12	.10 - .12	.15 - .17
Fusel oil, crude, drums, gal	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Glaubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.12½- .13	.12½- .13	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.07½-	.07½-	.08½-
White, basic sulphate, sck., lb.	.07 -	.07 -	.08 -
Red, dry, sck., lb	.08 -	.08 -	.09½-
Lead acetate, white crys., bbl., lb.	.11 - .12	.11 - .12	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb	.07 -	.07 -	.08½-
Lithopone, bags, lb.	.04½- .05	.04½- .05	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½- .07
Methanol, 95%, tanks, gal.	.38 -	.38 -	.43 -
97%, tanks, gal.	.39 -	.39 -	.45 -
Synthetic, tanks, gal.	.40½-	.40½-	
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Single, bbl., lb.	.10½- .11	.10½- .11	.13 - .13½
Orange mineral, csk., lb	.10 -	.10½-	.11½-
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08½- .09
Cyanide, cs., lb.	.55 - .57	.55 - .57	.52 - .55
First sorts, csk., lb.	.08¾- .09	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton	37.15 -	37.15 -	36.75 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.06 - .07¾
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	15.00 -18.00	15.00 -18.00	22.00 -25.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.32 -
Dense, bags, cwt.	1.17½-	1.17½-	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.90 - 3.00
Acetate, works, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	16.00 -18.00
Bisulphite, bbl., lb.	.03¾- .04	.03¾- .04	.03¾- .04
Chlorate, kegs, lb	.05½- .07½	.05½- .07½	.06½- .06½
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.16½- .17	.17 - .18	.18 - .22
Fluoride, bbl., lb.	.08 - .08½	.08 - .08½	.08½- .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	2.05 -	2.07 -	2.16 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.0265 - .03	.0265- .03	.03½- .03¾
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.70 - .80
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.03½- .04
Sulphite, cyrs., bbl., lb	.03 - .03½	.03 - .03½	.02½- .03
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.07 - .08
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -	nom. -	nom. -
Oxide, bbl., lb.	.29½-	.27½-	.41 -
Crystals, bbl., lb	.26 -	.25 -	.30½-
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.41 - .42	.40 - .41
Dust, bbl., lb.	.06 - .07	.06 - .07	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½-$0.11	$0.10½-$0.11	$0.12 -$0.13
Chinawood oil, bbl., lb.	.07 -	.07 -	.11½-
Coconut oil, Ceylon, tanks, N.Y., lb.	.04½-	.04½-	.06½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.07½-	.07½-	.07½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.06½-	.06½-	.07 -
Linseed oil, raw, car lots, bbl., lb.	.094-	.088-	.138-
Palm, Lagos, casks, lb	.06 -	.06½-	.07½-
Niger, casks, lb.	.05¾-	.06½-	.07 -
Palm Kernel, bbl., lb.	.05½-	.05½-	.07¾-
Peanut oil, crude, tanks (mill), lb	.07 -	.07 -	.07½-
Rapeseed oil, refined, bbl., gal.	.56 - .58	.56 - .58	.71 - .73
Soya bean, tank (f.o.b. Coast), lb.	nom.-	.08 -	.09½-
Sulphur (olive foots), bbl., lb.	.06 -	.06½-	.08½-
Cod, Newfoundland, bbl., gal.	.42 - .45	.42 - .45	.59 - .60
Menhaden, light pressed, bbl., gal.	.34 - .36	.34 - .36	.67 - .70
Crude, tanks (f.o.b. factory), gal.	nom.-	.20 -	.45 -
Whale, crude, tanks, gal	.78 -	.78 -	- .80
Grease, yellow, loose, lb.	.02¾-	.02¾-	.06½-
Oleo stearine, lb.	.07½-	.07½-	.11½-
Red oil, distilled, d.p. bbl., lb.	.08½-	.08½-	.10½- .11
Tallow, extra, loose, lb	.03½-	.03½-	.06½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .32
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb....	1.10 - 1.25	1.10 - 1.25	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - 67	65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.....	.57 - 60	.57 - .60	.57 - .60
Benzyl chloride, tech., dr., lb....	.30 - 35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal..	.20 - .21	.20 - .21	.23 - .24
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.54 - 58	.54 - .58	.73 - .75
Diethylaniline, dr., lb.	.55 - 58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.30 - 31
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.26 - .28
Diphenylamine, bbl., lb.	.38 - 40	.38 - .40	.39 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.63 - .55
Naphthalene, flake, bbl., lb.	.03¾- .04¼	.03¾- .04½	.04¼ - .05
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.52 - 53
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb.	.30 - .40	30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.75	1.50 - 1.80	1.75 - 1.90
R-salt, bbl., lb.	.40 - .44	.40 - .44	.44 - .45
Resorcinal, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.25 - .30	.25 -......	.30 -......
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.91 - .93
Toluene, tanks, works, gal.	.30 -......	.30 -......	.40 -......
Xylene, com., tanks, gal.	.25 - .28	.25 - .28	.28 - .30

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton...	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	08½- 11½	08½- .11½	.14 - .16
China clay, dom., f.o.b. mine, ton	8 00 -20.00	8 00 -20.00	8 00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	03 - 20	03 - 20	05 - 22
Prussian blue, bbl., lb.	35 - 36	35 - .36	.35 - .36
Ultramine blue, bbl., lb.	06 - 32	06 - .32	.03 - .35
Chrome green, bbl., lb.	27 - 28	27 - 28	.27 - .30
Carmine red, tins, lb.	5.00 - 5.40	4 40 4 80	5.25 - 5 50
Para toner, lb.	75 - .80	75 - 80	.70 - 80
Vermilion, English, bbl., lb.	1 70 - 1 80	1 70 - 1 80	1 80 - 1.85
Chrome yellow, C. P., bbl., lb	16½- 17	16½- 17	.17 - .17½
Feldspar, No. 1 (f.o.b. N.C.), ton	6 50 - 7 50	6 50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	07 - .08½	.07 - .08½	.04 - .05
Cum copal Congo, bags, lb.	06 - .08	.06 - .08	.07½- .08
Manila, bags, lb.	.16 - .17	.16 - .17	.16 - 17
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.22 - .23
Kauri No. 1 cases, lb.	.45 - .48	45 - 48	.48 - 53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 -55.00	50 00 -55.00	50.00 -55.00
Magnesite, calc, ton.	40.00 -......	40 00 -......	40 00 -......
Pumice stone, lump, bbl., lb.	.05 - .07	05 - .08	05 - 07
Imported, casks, lb.	03 - .40	03 - .40	03 - 35
Rosin, H., bbl.	6.00 -......	5 75 -......	8 20 -......
Turpentine, gal.	.53 -	46 -......	.54½-......
Shellac, orange, fine, bags, lb	41 - .42	41 - .42	55 - .58
Bleached, bonedry, bags, lb.	30 - .31	28 - 30	38 - .40
T. N. bags, lb.	.18½- .19	17 - 18	33 - 35
Soapstone (f.o.b. Vt.), bags, ton	10 00 -12.00	10 00 -12 00	10 00 -12 00
Talc. 200 mesh (f.o.b. Vt.), ton..	8.00 - 8.50	8.00 - 8.50	10 50 - ..
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7 50 -10 00	7 50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -......	13.75 -......	13 75 - ....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0 21 -$0 24	$0 21 $0 24	$0 27 $0 29
Beeswax, ref., light, lb.	.26 - .30	.29 - .30	.36 38
Candelilla, bags, lb.	.13½- .14	.14 - .15	19 .20
Carnauba, No. 1, bags, lb.	.21½ .22	.22 - .24	.31 .32
Paraffine, crude			
105-110 m.p., lb.	.03¼- .03¾	.03¼- .03¾	04¾ .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton.	80.00-85.00	80.00-85.00	100 00-.....
Spiegeleisen, 19-21%, ton.	30.00	30.00-.....	33.00 .....
Ferrosilicon, 14-17%, ton.	39.00-.....	39.00-.....	45.00-.....
Ferrotungsten, 70-80%, lb.	1.10	1.10-.....	1.45 .....
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.50	3.15-3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.10¼	$0.10¼-......	$0.17¾-......
Aluminum, 96-99%, lb.	.23¾	.23¾-......	.24 - .25
Antimony, Chin. and Jap., lb.	.07¼	.075	.08½-......
Nickel, 99%, lb.	.35 -......	.35 -......	.35 - ......
Monel metal, blocks, lb.	.28 -......	.28	.28 - ......
Tin, 5-ton lots, Straits, lb.	.2715-......	.26½-......	.36½-......
Lead, New York, spot, lb.	045-......	.045-......	.055 -......
Zinc, New York, spot, lb.	.0435-......	.0437-......	.053 -......
Silver, commercial, oz.	295	.294	41¾-......
Cadmium, lb.	55	.70 - .75	85 - .95
Bismuth, ton lots, lb.	1.40 -......	1 25 -......	1 70 -......
Cobalt, lb.	2.50 -......	2.50 -......	2 50 -......
Magnesium, ingots, 99%, lb.	48	.48	85 - 1.10
Platinum, ref., oz.	30 00	36 00	55 00 56.00
Palladium ref., oz.	19.00- 21.00	19 00- 21 00	30 00 35 00
Mercury, flask, 75 lb.	100 00-......	103.00	120 00-......
Tungsten powder, lb.	1 65	1 65	1.35- 1.50

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.	$6 50- $8 25	$6.50- $8 2	$5 50- $8 75
Chrome ore, c.f. post, ton.	19 00- 24 00	19 50- 24 00	22 00- 23 00
Coke, fdry., f.o.b. ovens, ton.	2 75- 2 85	2 75- 3 85	2 85- 3 00
Fluorspar, gravel, f.o.b. Ill., ton.	17 25- 20 00	17.25- 20.00	18 00- 20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit.	25 - 27	27 - 28	31 - 36
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	35 - 40	35 - 40	48- .50
Monazite, 6% of ThO_2, ton.	60 0 -......	60 00 -......	60.00-......
Pyrites, Span. fines, c.i.f., unit.	13 -......	13 -......	.13 -......
Rutile, 94-96% TiO_2, lb.	10 - .11	10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit.	12 00 - 12.50	12.00 12.50	15.25 -16.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Aluminate Factory—Aluminate Co., 135-26 Hillside Ave., Jamaica, N. Y., is having preliminary plans prepared for the construction of a factory at 132nd St. and 91st Ave. Estimated cost $40,000. H. T. Jeffrey Jr., 90-50 Parsons Blvd., Jamaica, is architect.

Asbestos Factory — Smith Faris Co., 1150 Hodgkiss St., Pittsburgh, Pa., will soon award contract for the construction of a 1 story, 26 x 83 ft. asbestos factory. Estimated cost $40,000. Private plans.

Brass Plant — Toronto Brass Machine & Foundry Ltd., 74 Market St., Toronto, Ont., is having plans prepared for a 1 story brass plant on Leslie St. Estimated cost $40,000 to $50,000. J. A. Thatcher, 37 Cowan Ave., Toronto, is architect.

Brick and Tile Plant—Interests represented by J. Harnish, Hidden Valley Ranch, Hubbard Rd., Santa Barbara, Calif., plans the construction of a roofing, brick and floor tile plant at Santa Barbara. Will operate under the name of Montecito Clay Products Co.

Calcium Chloride—Dept. of Standards & Purchase, F. L. Morris, Supt., Albany, N. Y., will receive bids until Mar. 23 for 1660 ton of calcium chloride for Highway Dept.

Cellulose Plant — Tennessee Eastman Corp., Kingsport, Tenn., awarded contract for the construction of first unit of plant, 4 story, 100 x 580 ft. for the manufacture of cellulose yarn, 2,500,000 lbs. annual capacity to Ridge Construction Co., 355 Lewiston Ave., Rochester, N. Y. Estimated cost $1,000,000.

Cement, Asphalt, Calcium Chloride, etc. — County Commissioners, Luzerne County, Wilkes Barre, Pa., will receive bids until Mar. 24, for portland cement, natural rock asphalt, calcium chloride and concrete pipe for delivery during 1931.

Cement Plant Equipment — City of London, Ont., A. Near, City Engr., interested in prices on complete equipment for civic cement plant, $25,000.

Chemical Plant—Allied Tar & Chemical Corp., D. W. Blaine, V. Pres. and Gen. Mgr., South Bayway, Elizabeth, N. J., postponed construction of chemical plant on Richmond St. $40,000. Architect not selected. Indefinite when project will mature.

Colortype Plant—American Colortype Co., 207 West 25th St., New York, N. Y., is having sketches made for addition and alterations to plant at Allwood, N. J. Estimated cost $40,000. Ballinger Co., 100 East 42nd St., New York, is architect and engineer.

Duraflex Plant—Duraflex Co. Inc., 11 East Pleasant St., Baltimore, Md., manufacturers of composition flooring, will build a 1 story addition to plant. Additional machinery and equipment will be installed.

Fertilizer Plant—Grasselli Chemical Co. Ltd., Federal Bldg., subsidiary of Canadian Industries Ltd., Temple Bldg., Toronto, Ont., awarded contract for the construction of a superphosphate fertilizer plant at Hamilton to Anglin-Norcross Ltd., Atlas Bldg., Toronto. Estimated cost $400,000.

Fumigation Plant—Dept. of Interior, Washington, D. C., will build a fumigation plant, 275 ft. long and 10 ft. wide at Presidio, Tex. Estimated cost $45,000. Private plans. Work will be done by day labor.

Gas Plant—Cape Cod Gas Co., P. P. Crafts, Secy., 1 State St., Boston, Mass., plans the construction of an illuminating gas plant at Barnstable. Estimated cost to exceed $40,000. Engineer not selected.

Gas Plant—Jersey Central Power & Light Co., Toms River, N. J., had plans prepared for the construction of a gas plant and storage tanks at Brighton Beach, Beach Haven. Estimated cost $40,000. Private plans.

Gas Generator Plant — Queensboro Gas & Electric Co., 1610 Central Ave., Long Island City, N. Y., plans the construction of a 37 x 59 ft. gas generator plant at Beach Channel Drive and Beach 108th St., Rockaway Beach. Estimated cost $40,000. C. L. Phillip & Co., c/o owner, is architect.

Glass Factory—Owens-Illinois Glass Co., W. I. Cole, Mgr., 133 Kearny St., San Francisco, Calif., is having plans prepared for the construction of a glass factory at Oakland. Estimated cost $1,000,000. Private plans.

Glass Manufacturing Plant—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans the construction of a glass manufacturing plant and terminal at Marysville, Mich. Estimated cost to exceed $200,000. Maturity indefinite.

Laboratory — Dept. of Hospitals, Municipal Bldg., New York, N. Y., plans the construction of a laboratory, etc. at Ave. C and 16th St. Estimated cost $40,000. Landsman & Smith, 105 West 40th St., New York, are architects. Will mature soon.

Laboratory — Madison State Hospital, North Madison, Ind., received lowest bid for the construction of a group of buildings including laboratory, etc. from E. Ainsworth & Son Construction Co., 1248 Hulman St., Terra Haute. Estimated cost $150,000. Foltz, Osler & Thompson, Architects Bldg., Indianapolis, are architects.

Laboratory—New York State c/o Saratoga Springs Commission, Albany, N. Y., is having revised sketches made for the construction of a laboratory at Saratoga Springs. $500,000. Maturity late in April.

Laboratory — University of California, Los Angeles, Calif., awarded contract for the construction of a 2 story laboratory (Scripps Institute of Oceanography) at La Jola, to Jarboe Construction Co., San Diego, $63,000.

Laboratory — Bd. of Regents, University of Texas, J. W. Calhoun, Comptroller, Austin, Tex., awarded contract for a 5 story, 80 x 150 ft. laboratory at Galveston, to J. E. Morgan & Son, 319 Texas St., El Paso. Estimated total cost $350,000.

Laboratory—Women's College Hospital, Surrey Pl., Toronto, Ont., is having plans prepared for a 4 story hospital including laboratory, etc. Estimated cost $400,000. Stevens & Lee, 62 Charles St. E., Toronto, are architects.

Laboratories—Dept. of Health, 505 Pearl St., New York, N. Y., will receive bids about Apr. 1 for the construction of a baby health center, X-Ray laboratory, etc., at 349 East 140th St. K. Murchison, 101 Park Ave., New York, is architect. Also plans baby health center, and X-Ray laboratory at Flushing. Estimated cost $150,000 and $150,000 respectively. Maturity indefinite.

University Building — Alfred University, Alfred, N. Y., will receive bids about Apr. 30 for clay working and ceramics work shop and school building. Estimated cost $150,000. Childs & Smith, 720 Michigan Ave., Chicago, Ill., are architects.

Lead—Supply Dept., P. C. Chapman, Supt., Boston, Mass., will receive bids until Mar. 25 for nine tons of powdered arsenate of lead for Park Department.

Leather Finishing Plant—C. M. Stone Co., 456 Benefit St., Providence, R. I., is receiving bids for a 2 story leather finishing plant on Winchendon St. Estimated cost $50,000. F. E. Field, 5 Euclid Ave., Providence, is architect.

Manganese Plant — Cuban-American Manganese Corp., controlled by Freeport Texas Corp., 122 East 42nd St., New York, N. Y., plans the construction of first unit of plant including steam shovel mining operations, construction of milling, grinding and flotation plant, cintering plant, etc. at Santiago, Cuba. Private plans. Estimated cost $1,500,000. Work will be done by day labor and separate contracts. Maturity indefinite.

Match Factory—International Match Co., 25 West 43rd St., New York, N. Y., will soon award contract for the construction of a 1 story factory, including two warehouses and five outbuildings at Jackson, Miss. $80,000; also received lowest bid for a factory at Natchez, from T. Wilmouth, Camden, Ark. $107,954. N. W. Overstreet, Mississippi Fire Insurance Bldg., Jackson, is architect.

Metals Separation Plant—International Nickel Co., Coppercliffe, Ont., awarded contract for a precious metals separation plans to Fraser-Brace Engineering Co., 107 Craig St. W., Montreal, Que. Estimated cost $1,000,000.

Paint Factory—Grasselli Chemical Co., Inc., 256 Liverpool Pl., Newark, N. J., awarded contract for a 2 story addition to paint factory on Vanderpool St., to Ratzler Co., 11 Hill St., Newark. Estimated cost $40,000.

Paper Plant—Johnson & Wierk, Grand Central Terminal, New York, N. Y., Archts., are receiving bids for a 2 story paper plant including turbine at Ridgefield Park, N. J. for Continent Paper Co., River Rd., Bogota. Estimated cost $40,000.

Paper Bag Factory—Bates Valve Bag Co., Seattle, Wash., plans the construction of a 1 story plant for the manufacture of heavy-duty paper bags for packing cement, lime, etc. 150,000 bags daily capacity at 625 West Spokane St. Estimated cost $80,000.

Pulp Plant—Hammermill Paper Co., E. R. Behrend, Pres., East Lake Rd., Erie, Pa., plans improvements to pulp plant including rearranging of tracks, installing conveyor system, etc.

Plant—Taunton Pearl Works, 35 Vernon St., Taunton, Mass., will soon award contract for remodeling manufacturing plant. Estimated cost $50,000. Jackson & Moreland, Park Sq. Bldg., Boston, are architects.

Rayon Factory — Industrial Rayon Corp., H. S. Rivitz, Pres., West 98th St. and Walford Ave., Cleveland, O., plans the construction of a factory for the manufacture of viscose wrapping paper, on Walford Ave. Estimated cost $50,000. Christian, Schwarzenberg & Goode, 1286 Euclid Ave., Cleveland, are architects and engineers.

Refinery (Maple Sugar)—Les Producteurs de Sucre d'Erable de Quebec, C. Vaillancourt, Secy., 5 Begin Ave., Levis, Que., awarded contract for a 5 story, 60 x 240 ft. maple sugar refinery at Valley Junction, to J. Boily, St. Georges de Beauce. Estimated cost $105,000.

Refinery (Gasoline) — Apache Refining Co., Los Angeles, Calif., will build a 30,000,000 cu.ft. gasoline extraction plant at Altman, Tex., 5,000 bbl. capacity. Estimated cost $200,000. Private plans. Most of work will be done by owners forces.

Refinery (Oil)—F. Buford and E. W. Griswold, Tulsa, Okla., is having preliminary plans prepared for the construction of an oil refinery near Longview, Tex. $100,000. Also plans gasoline plant, 5,000 bbl. capacity at Henderson. $150,000. Work by owner's forces.

Refinery (Oil)—General Petroleum Corp. of California, Higgins Bldg., Los Angeles, Calif., will build an oil refinery including two 20,000 gal. tanks, etc. at Grants Pass, Ore. Estimated cost $30,000. Work will be done by day labor.

Refinery (Oil)—Southern Oil Refining Co., El Dorado, Ark., is having preliminary plans prepared for the construction of an oil and by-products refinery at Longview, Tex. Estimated cost $125,000. Private plans.

Refinery (Oil)—Stoll Oil Refining Co., 227 West Main St., Louisville, Ky., awarded contract for the construction of a pipe line from Hodgenville to Louisville, a distance of about 70 miles, also installation of additional equipment in refinery at Louisville. Estimated cost $200,000. Work will be done by owners forces.

Refinery (Oil)—Taylor Refinery Co., Tyler, Tex., plans the construction of a 15,000 bbl. refinery including two 20,000 and six 10,000 bbl. storage tanks, etc. Estimated total cost $350,000. Contract for tanks, etc. awarded to Wyatt Metal & Boiler Works, West Dallas St., Dallas.

Refinery (Oil)—Western Oil & Refinery Co., Central Bldg., Los Angeles, Calif., awarded contract for the construction of an oil refinery including three pump houses, oil storage tanks, dock, etc., 1,000,000 capacity at Portland, Ore. to Kern & Kibbie, 290 East Salmon St. Estimated cost $100,000.

Refinery (Petroleum) — Continental Oil Co., Ponca City, Okla., awarded contract for the construction of a petroleum refinery (oil distillation) to Alco Products Co., Dunkirk, N. Y., subsidiary of American Locomotive Co., 30 Church St., New York, N. Y. Estimated cost to exceed $40,000.

Rubber Factory—Anderson Rubber Co., 124 North Union St., Akron, O., awarded contract for a 2 story, 74 x 109 ft. factory for the manufacture of rubber balloons and specialties to Krumroy Construction Co., 225 West Exchange St., Akron. Estimated cost $50,000. Maturity June 1.

Silk Mill—Canova & Simone Silk Co., 182 Cedar St., Paterson, N. J., will soon award contract for the construction of a silk mill. Estimated cost to exceed $40,000. Lockwood Greene Engineers Inc., Pershing Sq., are engineers.

Rubber Products Factory — Weldon Roberts Rubber Co., 18 Oliver St., Newark, N. J., will not construct a 2 story factory at 361-65 6th Ave. $40,000. M. N. Shoemaker, 10 Bleecker St., Newark, is architect. Project abandoned.

Smelting and Refining Plant — American Smelting & Refining Co., 120 Broadway, New York, N. Y., plans addition to mill to double capacity at Red Indian Lake, Newfoundland. Work will be done by day labor and separate contracts. Also plans a smelter plant. Total estimated cost $500,000.

Tannery—La Tannerie du Nord, J. Lefelevre, Mgr., Mont Laurier, Que., plans the construction of a tannery. Estimated cost $15,000.

Tool Manufacturing Plant — Walker Turner Co., 66 York St., Jersey City, N. J., acquired the Bosch Magneto plant and plans additions and alterations at South Ave. and Beekman St., Plainfield. Estimated cost $40,000.

Tarvia-Lithic Plant—Barrett Co., River Rd., Edgewater, N. J., awarded contract for a 1 story tarvia-lithic plant for road materials, 500 ton daily capacity at Chimney Rock Rd., Bound Brook, to Millburn Machinery Co., Chimney Rock Rd., Bound Brook. Estimated cost $40,000.

Travertite Plant—P. Grassi Travertite Works, 1945 San Bruno Ave., San Francisco, Calif., is having preliminary plans prepared for a plant at Los Angeles. Estimated cost to exceed $60,000.

Welding Shops — Consolidated Steel Corp., 1200 North Main St., Los Angeles, Calif., is having plans prepared for 1 story, 120 x 750 ft. welding shops at Slauson Ave. Private plans. Work will be done by owner's forces.

INDUSTRIAL NOTES

CHAIN BELT Co., Milwaukee, has appointed Mr. Smallshaw in charge of the Cleveland office, Mr. Cocker in charge of its Buffalo office, and Frank Gary in charge of the St. Louis office.

SILICA PRODUCTS Co., has removed its offices to 62 Bluxome St., San Francisco.

INGALLS IRON WORK: has opened a new office at 306 Builders Bldg., Charlotte, N. C., under I. V. Hender.

ILLINOIS TESTING LABORATORIES, INC., Chicago, has appointed E. H. Vivier, 30 Church St., New York, its representative.

CLARENCE MORGAN & Co., 355 West Ontario St., Chicago, has given up its representation of American Solvents & Chemical Corporation.

FULLER LEHIGH Co., has moved its general offices from Fullerton, Pa., to 85 Liberty St., New York.

EDWARD VALVE & MFG. Co., East Chicago, Ind., has appointed Bell & Eiss, of Minneapolis, its representative. Watson-Stillman Co., Roselle, N. J., has purchased the business of the Borroughs Company, Newark, N. J.

JEFFREY MANUFACTURING Co. has opened an office at 602 Esterson Bldg., Houston, Texas, under Thomas B. Burke.

WEAVER BROTHERS Co., Adrian, Mich., is moving into its new plant and offices at 9205 Inman Road, Cleveland.

G. D. JENSSEN Co., sulphite mill engineers, has moved to enw offices at the Chrysler Bldg., New York.

THE DURIRON COMPANY, Dayton, has opened a new office at the General Motors Bldg., Detroit.

KANSAS CITY OXYGEN GAS Co., in line with its diversification of products, has changed its name to Puritan Trust Gas Corporation.

GEARS & FORGINGS, Cleveland, Ohio, has placed G. H. Davis in charge of the Pittsburgh office at 2818 Slallman St.

NORTHERN EQUIPMENT Co., Erie, Pa., has appointed as representatives: Bell & Eiss, Minneapolis, Minn.; J. W. Eshelman, Birmingham, Ala.; Economy Equipment Co., 301 Buder Bldg., St. Louis.

COPPER ALLOY FOUNDRY Co. has been organized at 150 Broadway, Elizabeth, N. J., to operate with the complete organization of the William J. Sweet Foundry Co., Newark, N. J., which has suspended operations. H. A. Cooper, president of the latter firm, is also president of the new one.